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THE BRICKBVILDER

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THE BRICKBUILDER.

AN ILLUSTRATED MONTHLY DEVOTED TO THE ADVANCEMENT OF ARCHITECTURE IN MATERIALS OF CLAY.

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EPHEMERAL CONSTRUCTION.

IT is always difficult to properly measure the results of effort of the passing generation. The nearness of view is a bar to clear perspective values, and we cannot properly compare the present with the past or even foretell future developments with any very great surety. At the same time we believe that certain general tendencies are not difficult of measurement even while in process of evolution, and the signs of the times certainly seem to indicate that we are about to begin a period of vast extension in building, or perhaps more properly in architecture. For a number of years now this country has been passing through a financial depression, and that, together with the imminence of war on our very borders, makes the prospect seem gloomy. There is, however, a fair evidence that we are preparing the way for architecture of a kind and on a scale in advance of anything that has gone before. It is only within a comparatively few years that our methods have been such as to admit of real permanence in our constructions. The fire-proofing systems, which are still so young in years as to have hardly attained a majority, have enlarged the possibilities for a degree of permanence which did not exist during the previous generation; and, more than that, we as a people have been awakened to the commercial value not only of good construction but of good looks, and it is believed that when the country has righted itself from the political troubles through which it is now passing and has regained a measure of its native buoyancy we will be ready to construct buildings which will be free from the ephemeral character of most of our recent public works.

The greatest building epoch which the world has ever seen was undoubtedly that which culminated during the first century after Christ, under the sway of the Roman emperors. The architecture produced at this period was characterized more than in any other way by the solidity, the enduring qualities of its construction. Other periods of art have far excelled it in pure art and esthetic perceptions, but the world to-day owes its best constructive ideas to the Romans. Unless we greatly misinterpret the signs of the times, the next quarter century will witness a very widespread return to some of the methods which marked the more important Roman buildings, and especially in the construction of walls and vaulted surfaces there is reason to believe that we are developing into a permanence of construction which will augur well for the possibilities of artistic growth. If any one were to visit a huge structure such as the new South Union Station, now in process of building in this city, an edifice which, taken altogether, is one of the largest which has ever been conceived by human thought, it would seem as if we were in the midst of an iron age, as if steel in its various forms was the important element in our buildings, as if it had come to stay, and was not only indispensable, but was unreservedly approved of by our constructors. Steel and its possibilities have undoubtedly increased the horizon of the architect and have added enormously to the possibilities of construction, and yet we question very often whether in an architectural and constructive sense we have not lost rather than gained by the use of this extremely adaptive material. A wall of huge solid masonry construction seems clumsy and antiquated by comparison with the slender shafts which we find in the basements of some of our tallest buildings, and the whole character of our streets has been changed very materially in the more recent constructions by the possibilities of steel. We will venture the broad assumption that aside from the question of pecuniary gain or commercial necessity there is not one thinking architect in ten who would not prefer to construct of solid masonry from foundation to garret rather than to, of his own choice, select the spider-like constructions which we seem obliged to resort to; and from a standpoint of architecture the constructive values of steel are but a poor compensation for the manifest deficiency of our public buildings in those qualities of breadth, solidity, and permanence which contribute so largely to the success of the old Roman work.

A love for the massive constructions of antiquity does not, however, oblige us to imitate them literally. The Romans used brick and concrete as brute materials which would overcome the thrusts of vaults and arches to such an extent that such things as iron ties or bands were not required, and the actual factor of safety in nearly all the Roman work is, therefore, so far in excess of anything which scientific construction would call for that the same results, namely, stability and permanence in appearance, could be obtained in modern work with far less sacrifice of space and internal arrangement. The very able article by Professor Baker, the first instalment of which appeared in the last number of THE BRICKBUILDER, is a move in the right direction towards the increasing of the possible reliance which can be placed upon good masonry. As the article very justly intimates, a brick pier or wall crushed by superimposed load is so rare a circumstance as to be almost unrecorded. We trust good masonry less than about any other material which is used in building.

The buildings erected from the designs of the late H. H. Richardson are preeminently characterized by the appearance of extreme solidity and permanence, though we imagine that Mr. Richardson

was by no means ahead of his generation in his knowledge of constructive values. In one of the largest of his structures he had planned for a brick pier to support a load running up into hundreds of tons. The builder, who was a cautious as well as a thinking man, after putting up the pier and imposing the load upon it, became alarmed at the size in proportion to the load, and, finding that the brickwork was loaded with something over 25 tons per foot, without saying anything to anybody made some experiments. He built a brick pier and proceeded to undertake to crush it, but he found the resistance so great that before it began to show any signs of weakness whatever he gave it up, and was perfectly satisfied that the pier as designed by Mr. Richardson was ample for the purpose, notwithstanding it was loaded with nearly twice as much as any of our building laws would permit. Since then he has always been a firm advocate of the strength of brickwork when properly laid.

We do not need the heavy constructions of the Romans, but we do need the solid character, and that character is only simulated by the use of steel. Furthermore, we feel that with the blessings of peace, and the consequent expansion of our industries and our wealth, we shall see an era of public building such as has never visited this country before, and it looks as if we would be ready for it with methods and ways of building which will give us the right to rank our buildings with the creations of the past which have survived for us. We do not consider a building in Europe which is a couple of centuries old as in any sense wearing out, and yet the average life of our structures here has been up to the present from thirty to forty years. This is not simply because methods of planning have changed, for we are using very largely the same methods that were followed in the time of the Renaissance, and, barring certain questions of practical interior arrangements, some of the old Roman and Florentine palaces could to-day be utilized, with very slight change, for a modern office structure. Consequently the short life of our modern buildings is not due to inadaptability so much as to the innate nature of our constructive methods.

A CORRECTION.

In the March issue of THE BRICKBUILDER there was illustrated a residence at Brookline, Mass., of which Henry Forbes Bigelow, Boston, was the architect. By mistake, the names of Winslow & Wetherell, were given as being the architects.

PERSONAL AND CLUB NEWS.

PARISH & SCHROEDER, architects, have removed their offices to the Bancroft Building, 3 W. 29th Street, New York City.

FRED M. TRUEX, architect, has opened an office at Red Bank, N. J. Catalogues desired.

THE firm of Wagner & Reitmeyer, architects, Trust Building, Williamsport, Pa., has been dissolved. Mr. Wagner will continue the business of the old firm.

ROBERT S. SOULE, architect, has opened an office in the Hennen Building, New Orleans. Catalogues and samples desired.

D. M. COLLIER, architect, has opened an office in the Lennon Building, Oneonta, N. Y. Catalogues and samples desired.

THE office of James Craddock, architect, Lincoln, Neb., was recently burned out. Mr. Craddock has opened an office in the Oliver Theater Building, and would be glad to receive catalogues and samples.

A COLLECTION of paintings by a group of American artists was exhibited at the St. Louis Museum of Fine Arts on the evening of March 29, and on the evening of April 12 there was shown a collection of paintings and drawings illustrating scenes of the Revolution, and also a collection of Favrile glass.

THE St. Louis Architectural Club held its regular monthly meeting on the evening of March 12 in their new quarters at 916 Locust Street. Drawings in their regular monthly competition were submitted, the subject being an engine house. First prize was awarded to Benno Jensen; Mr. Farberger, second mention; J. C. Stephens, third. J. W. Glnder and R. M. Milligan acted as judges. The problem for this month is a house for the club. In addition to this, Mr. E. Lasser has offered a prize for the best design for a horse stall in iron.

A REGULAR meeting of the T Square Club was held on Wednesday evening, March 16. Mr. Louis C. Hickman spoke on the subject of the "Planning of a City Residence," and made some interesting observations on the possibilities of originality in such planning.

The subject for competition for the evening was "The Façade of a City Residence," *apropos* of which were Mr. Hickman's remarks. First mention was awarded to Horace H. Burrell; second mention, to Edward Gilbert; and third mention, to W. C. Scheetz.

A Club Smoker and Special Competition in Decoration was also held on March 2. First mention was awarded to Nicola d'Ascenzo; second mention, to Horace H. Burrell. Mr. Frank Miles Day led the criticism on the drawings submitted, and also gave an informal talk on the New Congressional Library at Washington.

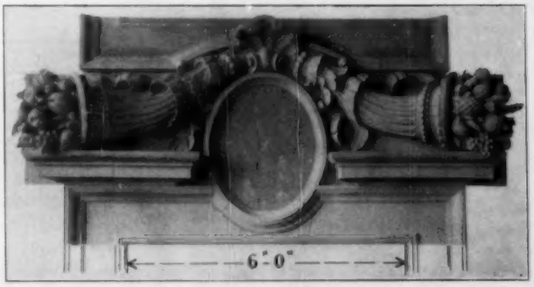
ILLUSTRATED ADVERTISEMENTS.

THE Commercial Cable Company's building, New York, Harding & Gooch, architects, is illustrated in the advertisement of the Excelsior Terra-Cotta Company, page iv.

The Phœnix Mutual Life Insurance Company's building, Hartford, Conn., Cady, Berg & See, architects, is illustrated in the advertisement of the New Jersey Terra-Cotta Company, page viii.

Number ten of the series of Brick and Terra Cotta Fireplace Mantels, of which J. A. Schweinfurth is architect, is illustrated in the advertisement of Fiske, Homes & Co., page vii.

A residence at Baltimore, J. A. & W. T. Wilson, architects, is illustrated in the advertisement of Harbison & Walker Company,



DETAIL BETWEEN SIXTH AND SEVENTH STORY WINDOWS, HOTEL MARTINIQUE, NEW YORK CITY.
Terra-cotta and brick by the New York Architectural Terra-Cotta Company.
H. J. Hardenbergh, Architect.

page xv. This building has been shown previously in this advertisement, but by mistake was titled a residence at Pittsburgh, Pa.

The basement floor construction of the American Soda Fountain Company's new building, Boston, Kendall, Taylor & Stevens, architects, is shown in the advertisement of R. Guastavino, page xxiv.

The Bank of Commerce Building, New York City, James Barnes Baker, architect, is shown in the advertisement of Henry Maurer & Son, page xxv.

The New Hospital Building at Eastern Ohio Asylum for the Insane, Massillon, Ohio, Yost & Packard, architects, is shown in the advertisement of the Celadon Terra-Cotta Company, Charles T. Harris, Lessee, page xxix.

The new Delmonico Building, Fifth Avenue, New York City, James Brown Lord, architect, is shown in the advertisement of the New York Architectural Terra-Cotta Company, page xxx.

The American Schoolhouse. VI.

BY EDMUND M. WHEELWRIGHT.

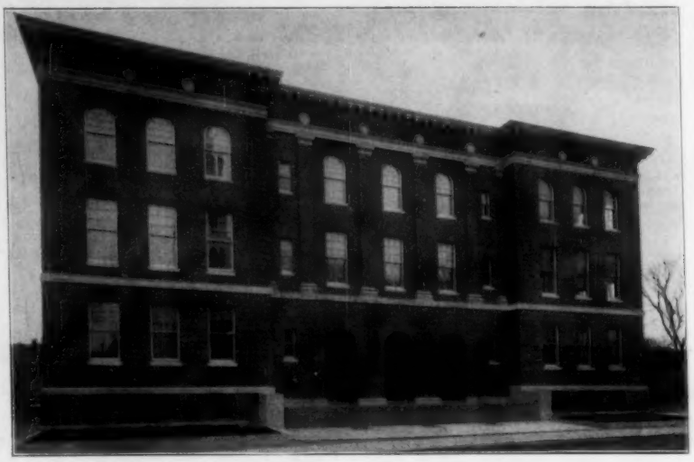
MR. WILLIAM ATKINSON writes concerning his plan published in the March paper of this series: —

"The plan is an attempt to reduce an eight-room schoolhouse to its lowest terms; in other words, to arrange four schoolrooms and four wardrobes on each floor, in the most compact manner possible.

"As an example of the economy of floor space attained in this plan, take the second floor. On this floor only 23 per cent. of the total area is devoted to hallways, stairways, heating and ventilating flues, and thickness of walls and partitions, or, in other words, 77 per cent. of the whole area is actually utilized.

"The following fixtures will illustrate this point: —

Area of building (53.9 by 92.3)	4,974.97 sq. ft.
This area is made up as follows, on the second floor: —	
Four class rooms at 768	3,072.00 sq. ft.
Four wardrobes at 117.8	471.20 sq. ft.
Two teachers' rooms at 100	200.00 " "
Total utilized area (77 per cent.)	3,743.20 " "
Space occupied by halls, stairs, flues, walls, and partitions (23 per cent.)	1,231.77 sq. ft.
	4,974.97 " "



GILBERT STUART SCHOOL, BOSTON, MASS.
Edmund M. Wheelwright, City Architect.

"In schoolhouse plans of the ordinary elaborate type, in which large areas are devoted to hallways, corridors, and passages, it often happens that less than 50 per cent. of the total area of the plan is utilized in rooms actually devoted to the purposes of the school.

"The amount of money to be spent in floor space devoted to hallways and corridors is a question for school committees to decide in any given case. This plan, as stated above, is an attempt to get the thing down to its lowest terms.

"One important feature of this plan is in the location of the stairways, which are placed at opposite ends of the building and in *separate* hallways not connected with each other, so that if one hallway should become filled with smoke, in case of fire, the other hallway would still give a safe way of egress to the inmates of the building.

PLANS, GILBERT STUART SCHOOL, BOSTON, MASS.

"This plan attains an economy of construction, as compared with the ordinary type of plan, in the following ways: —

"1. By a reduction of area, as explained above.

"2. By a reduction in the amount of interior partition wall.

"3. By a reduction in the height of the building obtained by reducing the thickness of the floors and by running the windows clear up to the ceiling.

"4. By a reduction in cubical contents by the use of the flat roof.

"5. By eliminating cut stone as far as possible.

"6. By simplicity of construction.

"The main proposition of my father's pamphlet is that an eight-room schoolhouse of two stories and a basement, with class rooms of the ordinary dimensions (28 by 32), may be planned to cover a ground area of not over 5,734 sq. ft., and that such a building ought not to cost over $30,000 complete, including grading of lot and architect's commission. This proposition was arrived at by theoretical reasoning.

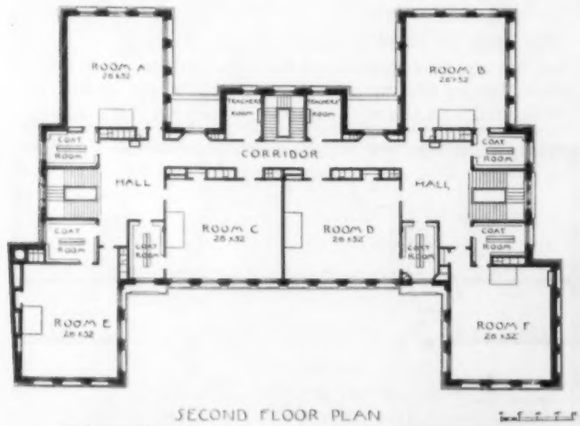
"It has been my purpose in working out these plans to show that the proposition is a sound one, and capable of being demonstrated in practical form.

"My plan with rooms 28 ft. wide instead of 24 would cover a ground area of 5,713.37 sq. ft., substantially the same as the hypothetical figure given in the pamphlet. This shows that the first part of the proposition is correct. And from estimates which I have made I am satisfied that the plans as shown (but with class rooms 28 instead of 24 ft.) could be executed complete for considerably less than $30,000 in the vicinity of Boston."

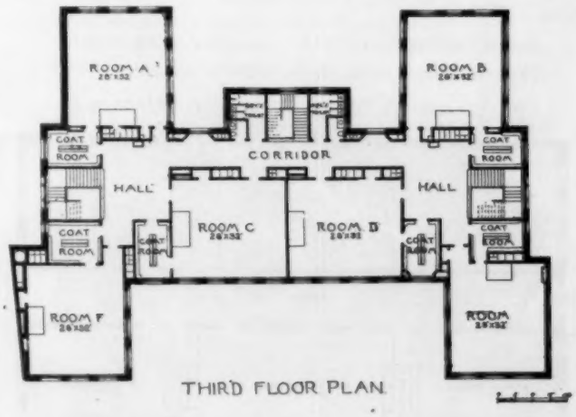
My opinion in regard to Mr. Atkinson's proposition is so fully given in my last paper that further discussion of the subject appears to be unnecessary.

As a result of the consideration of schoolhouse costs, previously given in these papers, the following general conclusions may be drawn: —

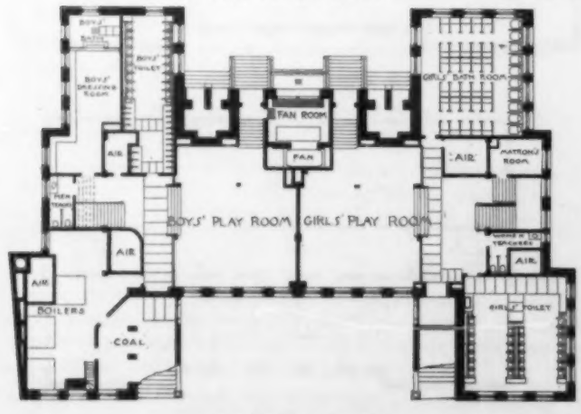
The addition of a schoolroom would appear to decrease the



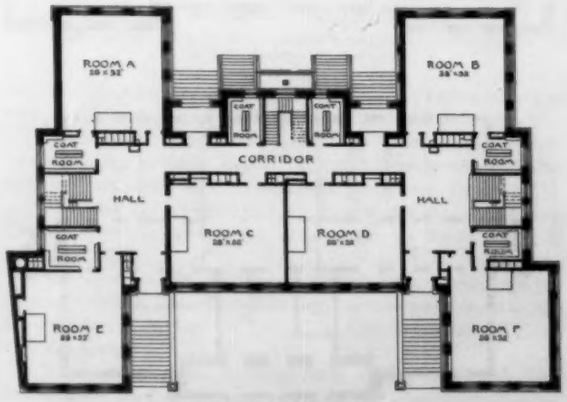
SECOND FLOOR PLAN



THIRD FLOOR PLAN



BASEMENT PLAN



FIRST FLOOR PLAN

PLANS, PAUL REVERE SCHOOL, BOSTON, MASS.

cost of a schoolhouse by about 2 per cent. The percentage of decreased cost will probably be less in buildings in excess of sixteen-schoolroom capacity.

Given an equal number of rooms, the cost of a grammar schoolhouse is 4 per cent. greater than that of a primary school.

The same accommodation can be given at 15 per cent. less cost in a three-story than in a two-story schoolhouse.

Separate wardrobes adjoining schoolrooms, increasing the cost of schoolhouse 4 per cent. over the cost of buildings of same number of rooms in which the clothing is hung in the corridors.

An increase of 4 ins. in one thickness of brick walls increases the cost of schoolhouse construction about 4 per cent.

Leaving out of consideration any additional thickness of brick walls which may be entailed thereby, the cost of double run of sash in schoolrooms increases the cost of schoolhouses about 1¼ per cent.

CAMBRIDGE HIGH SCHOOL, CAMBRIDGE, MASS.
Chamberlin & Austin, Architects.

The unusually severe requirements of the Boston Building Laws as revised in 1892 increased the cost of schoolhouse construction fully 9 per cent. without compensating advantage. The floor, for instance, had to be constructed to carry a live load of 150 lbs. per square foot in addition to the weight of the floor itself. This condition alone increased the cost of construction of Boston schoolhouses 2½ per cent.

When the Boston Building Law was further revised in 1897 and it was required that all schoolhouses should be of "fire-proof" construction, no change in this requirement of excessive strength of floors was made.

Previous to the passage of this law but two schoolhouses had been built in Boston with fire-proof floors, the Latin and English High and the Andrews School. The fire-proof floors in the Andrews School increased the cost of construction about 20 per cent. The Andrews School building was a nine-room, three-story, primary schoolhouse with roof of wooden construction. If such a building were built to-day with roof as well as floors of steel beam and terra-cotta arch construction, the cost would probably have been increased about 25 per cent. above that of a building of the same grade and size but with floors and roof of wooden construction.

ENTRANCE, CAMBRIDGE HIGH SCHOOL.

The Gilbert Stuart Grammar School, built with floors and roof of wooden construction, cost $6,193 per schoolroom. It is a fourteen-schoolroom building with assembly hall. It is probable that if of fire-proof construction throughout, its cost would have been increased 22 per cent., or to $7,555 per schoolroom. Leaving out of consideration the cost of plumbing and heating, the cost per schoolroom of such a building of fire-proof construction would have been $6,855 per schoolroom.

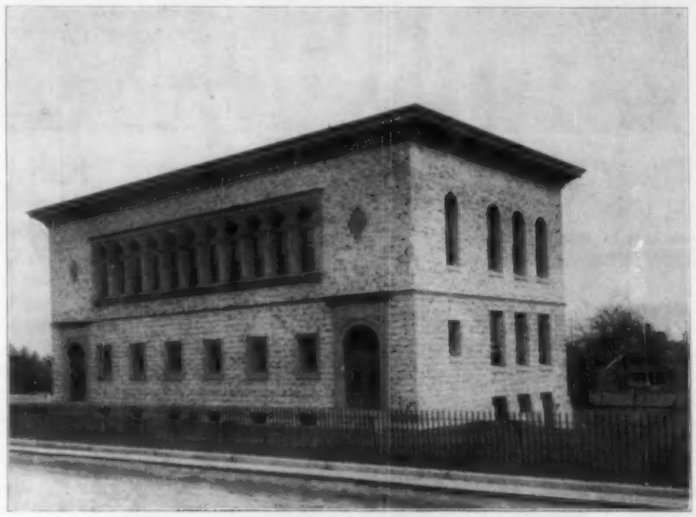
Since the construction of the Latin and English High School, which was completed in 1881, the Paul Revere School is the first wholly fire-proof school building built for the city of Boston. It is an eighteen-room building costing $152,406, or $8,488 per schoolroom. Since the plumbing was more elaborate in this building than in any previous school, bath rooms being here provided, we find that if the plumbing, together with the heating, is deducted, the cost per schoolroom was $7,322. The Revere School was lighted by electricity, the Stuart School was not; the Revere School had upon the stairs Mason Safety Treads in place of rubber mats, and had oak instead of ash finish. These features probably increased the cost above that of Stuart School about $200 per schoolroom. It is reasonable to suppose that the more elaborate external treatment of the Revere School rendered the building 3 per cent., or $350 per schoolroom, more expensive than the Stuart School. On account of the restriction of the site the cost of the Revere School was increased by the necessity of adopting a broken plan so that proper lighting might be given to the schoolrooms; we certainly may judge that this increased cost was $5,000 above that of the Stuart School. This amount would fully account for the remaining difference of cost between the two schools, if we consider the Stuart School as being of fire-proof construction and costing $6,855 per schoolroom, with heating and plumbing not included.

It would appear from the above conclusions that under ordinary conditions of site and architectural treatment, the excess of cost of fire-proof construction above that of buildings constructed under the Boston Building Laws of 1892 would be about 22 per cent., *i. e.*, a building of the form and architectural treatment of the Stuart School can be built in Boston of

fire-proof construction, with heating, ventilation, and the customary plumbing, for $7,555 per schoolroom, and that it may be safely reckoned that an equally well-finished and appointed building, constructed in a perfectly safe and satisfactory manner, but of less expensive construction than is permitted by the present Boston Building Laws can be built, including plumbing and heating, for about $6,800 per schoolroom, or for but about $600 more per schoolroom than if constructed with wooden floors and roof under the requirements of existing building laws.

Consideration of the relative decrease in cost of school accommodations due to the size of building and to the use of three instead of two story buildings, leads to the conclusion that if the demands for school accommodation under the best hygienic and structural conditions are to be met with due consideration for economy, that instead of small two-story, large three-story schoolhouses should be built, that school buildings should not be less than three stories in height, that they should not contain less than the equivalent of sixteen rooms, and that where fire-proof construction is required, schoolhouses should not be less than four stories in height.

The schoolhouses lately constructed in New York City are built in accordance with the policy which should maintain in our large cities, if public education is to be given to our quickly increasing population without imposing an unfair burden upon the community. In that city the schoolhouses recently constructed are large fire-proof buildings of several, in some cases seven, stories in height. These later New York buildings are so important that they will later be given extended mention in these papers.



WILLIAMS SCHOOL, BOSTON, MASS.
Edmund M. Wheelwright, City Architect.

It is not only in New York that the method of economically meeting the needs of schools constructed in accordance with the most approved conditions has been adopted. We find that a like policy maintains in the country towns of New England. The system of small district schools is being abandoned in these towns, large school buildings are being built at convenient centers, and thus the benefit of better conditions in school construction are gained at, I believe, no greatly increased cost per pupil, even though the towns pay for the transportation of children living at long distances from the schools.

Although generous appropriations are made in our large cities for school buildings, there is generally complaint of insufficient accommodation for the school children. If building laws are not made needlessly severe, and if large buildings of three or more stories in height are more generally constructed, this condition need not exist. The disadvantage of long flights of stairs for children to climb is largely one of the imagination. This inconvenience can in great measure be obviated by the introduction of elevators, and by the utilization of the roofs for the playground of the children assigned to the schoolrooms of the upper stories. Roof playgrounds are an interesting innovation in school planning lately adopted in the New York City schoolhouses.

The rapid increase of population is often found to soon render small schoolhouses inadequate for the accommodation of the children of the neighborhood they were originally designed to serve. It should be borne in mind that with these small schools not only is the cost per schoolroom fully 20 per cent. greater than in the large three-story schools, but that the cost of grading, paving, and fencing, and the cost of janitor service and fuel, is relatively greater per pupil.

Too often saving in cost is made at the expense of truly economical and safe construction. In one large Ohio city where those in authority pride themselves upon the low cost of the schoolhouses, I found a building, four stories in height with stud interior partitions, furred walls, and no fire stops. It was unprovided with metal or brick ducts for ventilation. The foul air was supposed to find its way through the hollow spaces in floors and walls to the outer air. A more imperfect system of ventilation and a more ingenious fire trap than this method of construction could not well be devised. The rough surface of sawed lumber and the backs of plastered surfaces gave ready lodgment for dust, and the uncertainty of the direction of the air under such conditions gave no warrant that this dust was not breathed in by the occupants of the building.

It is hoped that members of school committees and others interested in schoolhouse construction will recognize that in such work great saving in cost can seldom be made except by sacrifice of desirable features, and that the permanent value of a building depends upon the knowledge, skill, and forethought used by the architect in the disposition of its parts, in the durability and fire-protected character of its construction, in the quality of its appointments and fittings; and finally, that the beauty of the design is no small consideration, but one which may fittingly be restrained within the limitations of brick construction. Such construction may be more or less elaborate, as the neighborhood, the site, and the size of the building may require.

Except in the special cases of buildings built by private gift as memorials, public schoolhouses demand no richer external treatment than can be given by properly designed brickwork with stone or terra-cotta trimmings. Ordinarily, with careful study, a satisfactory building can be produced if constructed of common brick of good quality. Variety can be given by the bondings of brickwork, by the use of various colored mortars in the brickwork of the several stories, and in the accentuation of certain features. To give variety of surface, and as a means of accentuation, different shades of red brick can be used with good results. By such simple means, schoolhouses may be constructed at a reasonable expense which will have a pleasing architectural effect, and few are now found to maintain that the architectural effect of a schoolhouse is an unimportant consideration, and that a beautiful schoolhouse does not do its part in the education of the young. Personally, I have regretted that I have ever built brick school buildings of the factory type. The percentage of cost between a school building designed with regard for architectural effect, and one of a purely utilitarian construction is not great. Under ordinary conditions, satisfactory architectural results may be obtained at an excess of cost of not more than 5 per cent. above that of the most "practical" construction. A careful reckoning of the cost of

the Brighton High School, the most elaborate school building designed by me, shows that but 8 per cent. of its cost was for architectural features. It will be generally admitted that a large building demands a greater relative cost for architectural effect than does a smaller one.

In designing a schoolhouse the architect should strive to produce not an English college building, a French chateau, or a "Romanesque" library, but a schoolhouse. The practical requirements of the problem demand in most cases symmetry of plan, and in all cases, lighting of the schoolrooms by wide and high windows. It is requisite that these windows should not have transom bars, and that either a flat roof or one of low pitch should be used. A high, well-lighted basement is also a requisite of a schoolhouse. The important rooms in the basement need ample windows, and a stud of 10 ft. is none too high for the proper installation of the heating apparatus. These requirements for the basement affect schoolhouse designing most radically.

Such being the general requirements which most influence the external expression of our schoolhouses, it will be found difficult to reconcile therewith features borrowed from the late English Gothic and the early English Renaissance.

Aside from economy in planning, which certainly leads to a balanced arrangement of rooms, and which, except in rare cases, precludes a picturesque and irregular disposition of these rooms, the key to the external expression of a schoolhouse is the size, and distribution, and form of windows which experience has shown to be best adapted for the needs of a schoolroom. This consideration of window treatment alone leads the architect who appreciates the economic and practical requirements of the problem to abandon picturesque treatments in a schoolhouse design, and to adopt those suggested by the brick architecture of the Italian Renaissance and by the Georgian work of England and this country. Sufficiently varied motives for the external expression of our schoolhouse plans can be found in these styles. Such motive may be used without sacrifice of the practical requirements of the buildings, while unity in the variation in design is permitted. Ample scope is given the designer by variation in texture and color of brickwork; by variety in detail, division, and accentuation of surface; in the treatment of roof, and in the mass and the proportion of the structure. By these means almost infinite opportunities for the expression of individual taste and skill are offered. Careful study in the application of these styles to schoolhouse construction will certainly tend to the greater refinement and perfection of the architectural expression of what is now a well-defined and generally satisfactory type of American building.

The architect to whom the designing of a schoolhouse is entrusted should accept the limitations imposed by the practical conditions of the problem. He should not seek to be "original," or to gain the semblance of a structure, however beautiful in its own time and for its own needs, which does not meet the requirements of an American schoolhouse. He may well be content to express in fitting architectural form the already well-developed schoolhouse plan. He will find profit by the study of the Cambridge High School. This building was, in my opinion, the first American schoolhouse which was designed in a truly artistic spirit; for here is found, with proper accentuation, good proportion, and refined detail, no sacrifice of the practical requirements which fitted the structure to its purpose.

THE recent earthquake in San Francisco, while proving very destructive to many buildings, offered another evidence of the strength of the modern steel structure. It is reported that the nineteen-story Claus Spreckles building, although swayed like a tree in the storm, was not injured in the least. The damage to buildings of ordinary construction was very considerable, while some, presumably of the older and weaker buildings, made an utter collapse.

The cyclone in St. Louis also gave pretty substantial evidence of the stability of this form of construction; for with all the destruction in that instance to wooden and other structures, the skeleton iron and steel buildings suffered little damage.—*Boston Herald.*

Strength of Brick Masonry.

(*Concluded.*)

BY IRA O. BAKER.

M. Am. Soc. C. E., Professor of Civil Engineering, University of Illinois, Champaign.

Effect of Different Mortars. The effect of the different kinds of mortar is shown in Table I. The results in this table are averages for different kinds of brick, various heights of piers, etc., and hence should be used only as showing the relative strength of different mortars.

TABLE I.

CRUSHING STRENGTH OF BRICK MASONRY.

Ref. No.	Kinds of Mortar.	No. of Tests.	Crushing strength of the masonry in lbs. per sq. in.	Strength of the masonry in terms of that of the	
				Brick.	Mortar.
1	1 lime, 3 sand	21	1,551	0.10	12.5
2	1 Rosendale, 2 sand	36	1,825	0.13	11.3
3	1 Portland, 2 sand	8	2,540	0.16	4.7
4	Neat Portland	1	2,315	0.15	0.7
5	1 Rosendale, 2 lime mortar . .	1	1,646	0.12	9.0
6	1 Portland, 2 lime mortar . . .	1	1,411	0.10	7.3

Note that the substitution of a 1 to 2 Rosendale natural cement for the lime mortar added 18 per cent. to the strength of the masonry, and that the substitution of a 1 to 2 Portland cement mortar added 66 per cent. There are so few observations with the last three mortars that it is unwise to attempt any generalizations as to these mortars.

The last two columns of Table I. give interesting data as to the strength of the masonry in terms of that of the brick and also of the mortar. The ratio between the strength of the masonry and that of the brick will depend upon the manner of testing the latter. The brick under consideration were ground to a plane and tested on their broad side between steel pressing surfaces. In connection with the last two columns of Table I., see Table III. following. According to that table, brick masonry with mortar composed of 1 part lime and 2 sand has 44 per cent. of the strength of the brick; and with 1 part Portland cement and 2 parts sand the strength of the masonry is 63 per cent. of that of the brick. Nothing is known as to the strength of the mortar in Table III.

In one particular the data of Table I. are disappointing. Evidently the mortar in the second and third lines was abnormally weak. Three six-inch cubes of each mortar were tested by crushing when fourteen and one half months old. The results are given in Table II.

TABLE II.

CRUSHING STRENGTH OF MORTARS.

Ref. No.	Kinds of Mortar.	Crushing Strength lbs. of the mortar in Table I, per sq. in.	Tensile Strength of Ordinary Mortar, lbs. per sq. in.	
			Min.	Mean.
1	1 lime, 3 sand	124	25	50?
2	1 Rosendale, 2 sand	162	180	266
3	1 Portland, 2 sand	545	320	475
4	Neat Portland	3,483	500	680
4a	Neat Rosendale	521	290	385
5	1 Rosendale, 2 lime mortar . . .	183	27	
6	1 Portland, 2 lime mortar . . .	192	68	

The last column of the table shows the minimum and mean tensile strength of ordinary mortar. It is known that the crushing strength of cement mortar is eight to ten times as great as the tensile strength. This shows that the 1 to 2 Rosendale and the 1 to 2 Portland mortars were astonishingly poor. The crushing strength of the 1 to 2 Rosendale mortars at fourteen and one half months was less than the minimum tensile strength of natural cement mortar at one year; and the crushing strength of the 1 to 2 Portland mortar was only 1.7 times as great as the minimum tensile strength of average 1 to 2 Portland cement mortar. In a letter to the writer of this, the officer in charge of the Watertown Arsenal said: "The cement was purchased in the market, and the maker's name is not known. The mortar was mixed by an ordinary mason, and was not tested in tension."

It is very unfortunate that the cement mortar was so poor. Mortar acts as a cushion to distribute the load of compression, and consequently the nearer the physical properties of the mortar approach those of the brick the more strength will be developed in the pier. The crushing strength of 1 to 2 Rosendale cement mortar should have been, say, ten times as much as it was, in which case the crushing strength of the masonry would certainly have been increased. Let us see if we can compute what it would have been. The third mortar in Tables I. and II. is four and one third times stronger than the first, and the third masonry is roughly two thirds stronger; therefore, assuming the crushing strength of the 1 to 2 Rosendale mortar to have been 1,500 lbs. per square inch (about eight times the minimum tensile strength in Table II), and applying the above ratio, the masonry with 1 to 2 Rosendale mortar would have had a strength of about 4,000 lbs. per square inch. Reasoning similarly, the masonry with 1 to 2 Portland cement would have stood something like 5,000 lbs. per square inch.

Effect of Size of Cross Section. The experiments show conclusively that the strength decreases as the area of the cross section increases. Twelve-inch piers are about 20 per cent. weaker than eight-inch piers, and sixteen-inch are about the same amount weaker than twelve-inch ones, — all under like conditions. There are comparatively few exceptions to these conclusions. The greater strength of the smaller pier is doubtless due to the better bonding.

Effect of Height of Pier. Naturally the strength of the pier decreased as the height increased. Averaging all the grades of brick together, and representing the height in feet by H and the diameter in feet by D, the crushing strength of piers may be represented by the following formulas: —

With 1 to 3 lime mortar,
the crushing strength in pounds per square inch $= 2{,}330 - 102\frac{H}{D}$. (1)
With 1 to 2 Rosendale mortar,
the crushing strength in pounds per square inch $= 2{,}520 - 104\frac{H}{D}$. (2)
With 1 to 2 Portland mortar,
the crushing strength in pounds per square inch $= 3{,}350 - 132\frac{H}{D}$. (3)

Hollow vs. Solid Piers. Seven piers 12 ins. square, with a hollow core 4 ins. square running from top to bottom, and four piers 16 ins. square, with a hollow core 8 ins. square, were tested. Nothing significant is shown by these experiments, the crushing strength per square inch of net area agreeing surprisingly with the values for solid piers of the same external dimensions.

Effect of Profile of Pier. One of the most interesting tests of the whole series is that of an 8 by 16 in. pier with a 16 by 16 in. base. The smaller section was connected to the larger by four courses, each of which projected on two sides an inch beyond the course next above it. The pier was 50 ins. high, the small section being 25 ins. high. The pier consisted of thirty courses of "face" brick in lime mortar, and was tested when two and one half months old. The average thickness of the joints was three sixteenths of an inch. This pier failed in the lower and larger portion under a stress of 601 lbs. per square inch, the upper and smaller portion showing no signs of failure under 1,233 lbs. per square inch. The problem is: Why did the pier fail in the larger portion under less than half the stress the smaller portion bore without any signs of failure?

Fig. 1, made from the pier now in the Masonry Laboratory of the University of Illinois, shows the cracks developed in the base section during the test. The only cracks are those shown in the illustration and similar ones immediately opposite in the back face. The cracks are approximately in the plane of side of the top section. Apparently the failure is due to the compression of that portion of the bottom section directly under the top section, thereby causing the compressed portion to shear off from the uncompressed part of the base section. This fact is very surprising and is important in designing footing courses. Probably if the base section had been thinner the pier would have been stronger, and possibly failure would have taken place in the smaller section.

A pier having an 8 by 8 in. top section of twenty courses, and a 15 by 16 in. bottom section of eight courses, with four contracting courses connecting the larger and smaller portions, laid in neat Portland cement mortar and tested when two and a half months old, failed in the smaller portion under 3,540 lbs. per square inch, the stress on the base section being 833 lbs. per square inch. In this case the difference between the upper and lower sections was too great to secure the effect discussed in the preceding paragraph.

FIG. 1.

Effect of Age. The experiments give little or no information as to the effect of age upon the strength of masonry. Four twelve-inch piers laid in 1 to 2 Rosendale cement mortar, tested when twenty-one months old, are comparable with four tested when six and a half years old. The first four gave an average strength of about 2,100 lbs. per square inch, while the second four gave about 2,000 lbs. per square inch. Notice that the younger masonry is the stronger. This difference is greater than can be accounted for by the *probable* error of the experiments; nevertheless, it may be due to error. However, it may be due to unsound cement.

Apparently masonry laid in lime mortar was the same strength at two and a half, fourteen, and twenty-four months of age. This condition is based on only two experiments of each age, and is therefore liable to considerable error. It is interesting, however, as showing the rapidity with which lime mortar gains its strength.

Effect of Various Elements. One twelve-inch pier with joints broken every sixth course, and one twelve-inch pier with the brick laid on edge, were tested, but the result is without special significance. It is impossible to draw any safe conclusions from a single test. The difference between the results for the two piers above and those for piers built in the ordinary way is not greater than the error of the experiments.

Six piers were tested with blue stone cap and base, but the stone did not materially affect the strength of the brick masonry, as might have been foretold.

A pier of face brick 12 ins. square and 6 ft. high, laid up hollow without any mortar, had a strength of 525 lbs. per square inch — about one third of a similar pier with mortar.

VALUES ALLOWED IN PRACTISE.

According to the building regulations of Berlin, the safe load for brick masonry is less than one tenth of the results in Table III.

TABLE III.

ULTIMATE STRENGTH OF BERLIN BRICK MASONRY.*

Ref. No.	Kind of Brick.	Average Crushing Strength of Brick, lbs. per sq. in.	Ultimate Strength, in lbs. per sq. in., of Brick Masonry with Mortar Composed of			
			1 Lime 2 Sand	7 Lime 1 Cement 16 Sand	1 Cement 6 Sand	1 Cement 3 Sand
1	Clinker Stock . .	5,390	2,370	2,590	2,960	3,410
2	Selected Stock .	3,669	1,620	1,760	2,020	2,320
3	Ordinary Stock .	2,930	1,290	1,390	1,610	1,850
4	Perforated . . .	2,759	1,210	1,320	1,520	1,710
5	Porous	2,617	1,150	1,250	1,440	1,650
6	Porous Perforated.	1,195	530	570	650	750

Table III. purports to give the ultimate strength of the masonry, and claims to be derived from experiments. The internal evidence is that it was not derived directly from experiment. If the strength of the brick in any line of Table III. be represented by 1, that of the corresponding masonry in the several columns will be represented by 44, 48, 55, and 63 per cent. respectively, which shows that the results were computed and not derived directly from experiment. However, these per cents. are interesting as showing the relation between the masonry and the strength of the brick, and also as showing the relative strength of the several grades of masonry. These per cents. correspond to the numbers in the next to the last column of Table I. It is not stated how the brick in Table III. were tested, but it is evident that they are very much weaker than those in Table I. (It will be remembered that the latter had a strength of from 11,000 to 18,000 lbs. per square inch when ground flat and tested on the broad side.) Although the brick of Table III. are much the weaker, the masonry is much the stronger. In Table III. the term "cement" almost certainly means Portland cement.

The pressure at the base of a brick shot-tower in Baltimore, 246 ft. high, is estimated at 6½ tons per square foot (about 90 lbs. per square inch). The pressure at the base of a brick chimney at Glasgow, Scot., 468 ft. high, is estimated at 9 tons per square foot (about 150 lbs. per square inch); and in heavy gales this is increased to 15 tons per square foot (210 lbs. per square inch) on the leeward side. The leading Chicago architects allow 10 tons per square foot (140 lbs. per square inch) on the best brickwork laid in 1 to 2 natural cement mortar, and 5 tons for ordinary brickwork in lime mortar. Ordinary brick piers 18 by 24 ins. by 10 ft. have been known to bear 40 tons per square foot (560 lbs. per square inch) for several days without any sign of failure.

Tables I. and III. appear to show that the above practise is very conservative with regard to the pressure allowed on brick masonry. According to Table I., the ultimate strength of ordinary brick masonry with lime mortar is 112 tons per square foot (1,551 lbs. per square inch); and with *good* 1 to 2 natural cement is certainly at least 130 tons per square foot (1,825 lbs. per square inch), and probably twice this amount; and with *good* 1 to 2 Portland cement is certainly 180 tons per square foot (2,540 lbs. per square inch), and possibly twice this amount.

The nominal pressure to be permitted upon brick masonry depends upon the kind of material employed; the degree of care with which it is executed; whether it is for a temporary or permanent structure, an important or unimportant structure; and, it may be added, the care with which the nominal maximum load is estimated. Hence it is illogical to attempt to use a constant factor of safety. The designer must use his judgment and his knowledge of the attendant conditions of the problem in hand.

* From "Abstracts of the Institute of Civil Engineers" (London), Vol. 79, p. 376.

On the Saline Efflorescence of Bricks.

THE CAUSES LEADING TO IT, AND THE PRACTICAL MEANS OF AVOIDING THE SAME.— *Continued.*

BY OSCAR GERLACH (PH. D., BERLIN).

BURNING.

THE efflorescences produced by the sulphates in the green brick or during the water-smoking are always visible on the surface of the burnt product, either in the form of whitewash or in that of minute warty, crystalline kernels. On the other hand, the burnt products may come from the kiln faultless in appearance and without a visible trace of coloration, and yet conceal in their interiors considerable quantities of sulphates, which, when the bricks are later wet by water, are dissolved and make their appearance at the surface. These salts arise always during the burning,— not before,— and are particularly annoying because of their usually appearing first in the finished buildings, where, through the effects of rain and frost, they gradually are drawn to the surface.

Hitherto the opinion has been erroneously entertained that, in *burning*, only the sulphurous acid gas due to combustion participates in the formation of whitewashing sulphates, whereas the undisintegrated iron pyrites still remaining in the clay was left entirely unnoticed. Now Dr. Hans Guenther, of Carlsruhe, has recently shown by a series of instructive experiments that also the iron pyrites *in the clay* participates in the formation of whitewashing sulphates during the burning; and this is readily intelligible when we reflect that the sulphurous acid gas, produced by the combustion, must act mainly on the surface of the bricks and can only gradually penetrate into their interior, whereas the combustion of the finely distributed iron pyrites in the brick itself brings the generated sulphurous acid gas into immediate contact with the finely distributed carbonates of the clay, and so renders possible a perfect absorption of the acid by the carbonates.

The formation of whitewashing sulphates during burning takes place as follows:—

A part of the sulphur in the iron pyrites (FeS_2) is very loosely combined with the iron, and oxidation of this part begins at approximately 650 degs. Fahr., whereas the other part burns only at red heat. The products of the disintegration are oxide of iron (Fe_2O_3) and sulphurous acid gas (SO_2). Expressed in chemical formulæ, we have:—

$$\text{I.} \quad FeS_2 + 2O = FeS + SO_2$$
$$\text{II.} \quad 2FeS + 7O = Fe_2O_3 + 2SO_2.$$

The sulphurous acid gas SO_2, when heated in contact with solid porous bodies, is oxidized by the superfluous oxygen of the air of combustion to sulphuric acid, or converts existing oxides into sulphuric salts. It was for a long time erroneously believed that the presence of water or of water vapor was necessary to the formation of sulphates; but as early as 1856 Plattner in his book, *Der metallurgische Röstprocess*, demonstrated experimentally that sulphurous acid gas in combination with the oxygen of the air and in contact with minute particles, or in contact with porous solid bodies, oxidizes to sulphuric acid, and that the water vapor in the air was not of consequence for the formation of this acid. If the minute particles or porous bodies are or contain oxides, these oxides are converted into whitewashing sulphuric salts. The following of Plattner's experiments is of special interest to the brickmaker. He conducted a mixture of sulphurous acid gas and atmospheric air, once wet and once dry, over some unslacked lime (CaO) in a glass tube. At red heat the lime was converted into calcium sulphate ($CaO + SO_2 + O = CaSO_4$) without a trace of sulphurous acid or sulphuric acid being noticeable at the free end of the tube. All the sulphurous acid, accordingly, was absorbed by the lime and converted by the oxygen of the air into sulphate of calcium. The same experiments were made with other oxides with the same results.

In the burning of clay products the same conditions prevail, pro-

vided the fuel contains sulphur and the clay contains carbonates of calcium, of magnesia, or of alkalies — which is to a greater or lesser extent usually the case. At red heat the carbonates, liberating their carbonic acid, are converted into their respective oxides, which, being finely distributed throughout the porous brick by the oxidizing action of the air, combine with the sulphurous acid gas to form whitewashing sulphates.

To turn these laboratory experiments to account for practical brickmaking, the experiments were made on a large scale. Different clays were burnt with different fuels, and the amount of sulphates contained in the products determined both before and after burning.

EXPERIMENT I. *Clay alone contains sulphur.*

Material. Clay containing both iron pyrites and a small quantity of carbonate of lime.

Mode of Burning. Red heat (about 1650 to 1750 degs. Fahr.). Gas furnace. Oxidizing flame. The gas employed showed only the merest traces of sulphur. A kilogram of the *unburnt* clay contained 0.584 grams $CaSO_4$, or calcium sulphate. A kilogram of *burnt* clay contained 2.874 grams of $CaSO_4$. *Result*, Since the fuel contained no sulphur, the *fivefold* increase of the amount of whitewashing sulphates in the burnt product must have been *entirely due to the presence of the iron pyrites in the clay.*

EXPERIMENT II. *Both the clay and the fuel contain sulphur.*

Material. Same clay as in Experiment I.

Mode of Burning. Red heat. Coal fuel. Oxidizing flame. Coal contained 3 to 4 per cent. FeS_2, or iron pyrites. The amount of sulphates was determined in *several* different burnt bricks. A kilogram of the burnt clay contained on an average 12.76 grams $CaSO_4$.

Result. A more than *twenty-fold* increase of the whitewashing sulphates.

EXPERIMENT III. *Fuel alone contains sulphur.*

Material. Clay free from iron pyrites, but containing much carbonate of lime.

Mode of Burning. Red heat. Fuel, coal, etc., as in Experiment II. One kilogram of the *unburnt* clay contained 0.483 grams $CaSO_4$. One kilogram of the *burnt* clay contained 16.85 grams $CaSO_4$.

Result. An almost *forty-fold* increase of whitewashing sulphates.

EXPERIMENT IV. *Clay and fuel free from iron pyrites (at least containing traces only).*

Material. Same as in Experiment III.

Mode of Burning. Gas furnace. Oxidizing flame. Red heat. One kilogram of the *unburnt* clay contained 0.483 $CaSO_4$. One kilogram of the *burnt* clay contained 0.621 $CaSO_4$.

Result. A very *slight* increase of whitewashing sulphate.

EXPERIMENT V. *Fuel free from iron pyrites. Clay containing great quantities of iron pyrites, but only traces of carbonate of lime.*

Material. Clay containing large quantities of iron pyrites, but almost free from carbonate of lime and other carbonates.

Mode of Burning. Gas. Oxidizing flame. One kilogram of the *unburnt* clay contained 0.321 grams $CaSO_4$. One kilogram of the *burnt* clay contained 0.518 grams $CaSO_4$.

Result. A *very slight* increase.

EXPERIMENT VI. *Fuel and clay both contain iron pyrites, but the clay shows only traces of carbonate of lime.*

The materials and the results were the same as in Experiment V.

CONCLUSION.— It follows from the above experiments that the whitewashing sulphates are formed in large and annoying quantities only when sulphurous acids and carbonate of lime, or other carbonates, *occur together* in chemical action. Sulphurous acid has no injurious effect on clays containing no carbonates of lime, magnesia, or alkalies. Such clays, accordingly, can be burnt with sulphurous coal without any fear of an increase of whitewashing sulphates, whilst clays containing carbonate of lime require a fuel free from sulphur.

Fire-proofing.

HOW TO BUILD FIRE-PROOF.

(Concluded.)

BY FRANCIS C. MOORE,

President of the Continental Insurance Co., N. Y.
Delegate of New York Board of Fire Underwriters to the Board of Examiners of the New York Building Department.

SUMMARY OF IMPORTANT POINTS.

FOUNDATION.

It is hardly necessary to deal with the foundations of buildings. The question is an engineering problem which hardly requires suggestions from a fire standpoint, and I shall not deal with it here, other than to touch again upon the important point of not having wrought-iron or steel columns in the cellar or basement, where moisture and gas conditions would increase the danger of rust.

ENCLOSING WALLS.

These, as already stated, should be of brick, the lower stories laid in cement mortar, not less than 16 ins. thick at the top of the building and increasing 4 ins. in thickness for every 25 ft. in height to the bottom. This would require a 44 in. wall at the grade for a 200 ft. building. The thicknesses here recommended are for buildings not exceeding 100 ft. in depth. If they exceed this depth without curtain or cross walls, or proper piers or buttresses, the walls should be increased in thickness 4 ins. for every additional 100 ft. in length.

Brick is the best known resistant of fire. Stone yields readily to the combined effect of heat and water, and even terra-cotta or burned clay tile cannot be regarded as a perfect substitute for hard-burned brick.

Under no circumstances should the iron framework of a skeleton building be incorporated in thin enclosing walls. No wall that has not a cross section sufficient to support itself without the iron-work should be allowed, aside from the importance of having it thick enough to prevent the passage of hot air from an adjoining building.

Curtain walls for enclosing walls supported by the longitudinal members of skeleton construction are objectionable; they are liable to be buckled out by the expansion of the framework. The great trouble with modern fire-proof structures, even under the New York building law, is that while the separating fire-proof floors tend to prevent the passage of flame from one story to another, the enclosing walls are often insufficient to prevent heat from igniting the contents of an adjoining building, so that what is gained by preventing the spread of fire vertically is lost laterally.

It should be borne in mind that the thickness of walls herein recommended is not for carrying capacity as bearing walls. Thinner walls would answer for that purpose. It is intended to confine the heat generated by a fire and should be required in the compact portions of cities, where every man should be compelled to build with reference to the safety of his neighbor.

Architects and builders generally seem to have in mind only the carrying capacity of walls and to lose sight of this important fact.

As the contents of a mercantile building and its floors burn they sink to the bottom, where enormously high temperatures are reached, and it is for this reason it is recommended that walls increase in thickness as they approach the bottom, on the same principle that the walls of smelting furnaces are thicker at the bottom than at the top.

It is the generally accepted opinion that a 12 in. brick wall will prevent the passage of fire, but a much thicker wall will fail to confine the heat of a burning building, on the first floor particularly, sufficiently to prevent the ignition of combustible merchandise or other material in an adjoining building. In a fire which occurred in Boston, several years ago, combustible material was ignited

through a 3 ft. wall, which became so hot as to thus conduct the heat into the adjoining building. In an isolated location an owner might be permitted to construct his walls with reference only to their carrying capacity, but where he builds in the compact part of a city, storing combustible materials from cellar to roof, he should be required to build so that a fire in his premises will not necessarily destroy his neighbor's property. He may well observe a regulation which, in view of the fact that the buildings of his neighbors outnumber his own a thousand to one, will ensure that he shall be in that proportion the gainer by rules which secure the safety of all though imposed on himself.

I do not believe "skeleton construction" so called should be permitted for stores, warehouses, or manufactories in cities, as the walls are not thick enough to confine the heat of burning merchandise.

In some of our Western cities, Detroit, Chicago, etc., the practise is growing of using hollow tiling, bonded like ordinary brickwork, 12 ins. thick, for enclosing walls, instead of brick, the exposed steel frame being protected by terra-cotta slabs about an inch thick. Such a building would burn more quickly than an ordinary wooden-joisted building properly constructed. The Leonard Building, in Detroit, destroyed by fire Oct. 7, 1897, was an example of the great danger of this style of construction. It was ten stories high, and as fast as the columns or wall girders were warped by the heat the tiling dropped out like loose bricks, leaving the entire structure after the fire a ragged cage-work of iron with very little of the tiling on the enclosing walls and none of the floors intact. The contents were, of course, totally destroyed.

PIERS, BOND STONES, ETC.

Bond stones should not be allowed in piers, especially in the cellar or basement, or in piers vital to the building or carrying great weights. Stone yields readily and quickly to the combined effects of water and heat and, disintegrating at its edges, gradually releases the bricks above it, so as, in time, to destroy the integrity of the pier. Bond stones are employed by the mason to steady his work. A green brick pier while being laid is frequently unsteady, and a bond stone enables him to progress with his work by steadying all below it so as to receive new courses of brick. In all cases the bond should be a cast-iron plate. If the plate should be cast with holes through it about 1½ ins. in diameter, so that the mortar and cement can thoroughly incorporate the plate with the masonry above and below, it would be an improvement. Wrought iron is liable to rust and should not be used. Where bond stones are used in the outer walls of buildings they are less objectionable, but for inside piers they are so dangerous that they ought to be prohibited by law. Strangely enough, only stone for bonds used to be required by the New York building law, and such was the opposition of the stone men to the prohibition of bond stones altogether, when later it was proposed, that a compromise was reached allowing the use of cast-iron bonds as an alternative of stone bonds — an option seldom availed of by architects, builders, or owners, however, and construed generally by the public to mean that either is good enough.

STONE PILLARS.

It not infrequently happens that a building of otherwise admirable construction has its weakest point in the cellar, where a stone pillar forms the basis of support of the entire line of columns through the building. In case of fire and the application of water these stone pillars, no matter how substantial, whether single monoliths or stone blocks, will rapidly disintegrate and bring down the entire structure; and inspectors should carefully examine, especially in the cellars, for such construction. After the great Boston fire, granite piers were shoveled up and carted away like so much sand. It is quite a common practise, but a most dangerous one, to employ single stone columns, often of polished granite, to support the center of a long stone lintel carrying the wall over the ornamental entrance of a building. Such a column would surely yield to the effect of fire and water and perhaps let down the entire front. In almost any city (and New York is no exception) such faulty architecture may be observed. The writer passes every day a costly structure on Fifth Avenue whose corner is supported by a single granite monolith column of this kind. If stone columns are desired for architectural effect they should, wherever they carry heavy loads, contain a center column of cast iron of sufficient carrying capacity to support the superimposed weight.

CAST-IRON VERTICAL SUPPORTS.

The vertical supports, columns, pillars, etc., as already stated, should be of cast iron, cylindrical in form, of liberal thickness, especially in the lower stories, thoroughly tested as to sand holes, thin places, etc. Cast-iron columns should be round, and not square. In the former shape there is less likelihood of defects in casting, sand holes, etc., resulting in uniform sound thickness of the shell. The columns should be planed to smooth bearings, so that the entire system of columns, from the foundation to the roof, may be securely bolted together and form a continuous line with joints for expansion and without any inequalities of bearings. Under no circumstances should wedges or "shims"* be allowed. This most important matter is often neglected. The flanges and corbel brackets for supporting beams should be cast in one piece with the column and not depend upon rivets or bolts. Rivets, aside from the danger of shearing strains, are almost certain to rust to the point of danger. The beams should be riveted or bolted to lugs on the columns, however, as a tie between the side walls, holding the entire structure firmly and consistently together as one rigid whole and yet with play for expansion.

Col. Geo. B. Post, of New York, has devised a form of cast-iron cage construction consisting of pillars and floor beams of the Hodgkinson pattern the members of which lock into each other, without the use of bolts or rivets, forming a very rigid construction and saving the cost of mechanics for bolt and rivet work. While I have not had an opportunity to examine it, I have great faith in his judgment; my impression, from his description of it, is that it would be very rigid construction and admirably adapted to warehouses six and seven stories high. Above this height merchandise should not be stored in any kind of a building.

The factors of safety, in computing strains, should not be less than those prescribed by the standard modern authorities. Better be sure than sorry.

FIRE-PROOFING IRON MEMBERS.

All ironwork, columns and pillars, beams and girders, should be fire-proofed, *i. e.*, covered with at least 4 ins. of incombustible material, terra-cotta or brick. At the floor, and for a height of 4 ft. in mercantile buildings, a metal guard should be employed to prevent the column from being stripped by collisions with rolling trucks for moving merchandise. It ought to be unnecessary to suggest that wooden lagging should, under no circumstances, be used to cover iron, were it not for the fact that in one of the largest and most costly dry-goods stores in New York, the fire-proof covering of the iron columns, which had been seriously damaged by trucks, was being systematically removed in order to substitute wooden lagging, when the fault was, fortunately, detected by an inspector of the underwriters. 4 ins. of good brick-work is a good covering, but porous terra-cotta or even wire lath and plaster may prove effective. Where wire lath and plaster is used the column should first be wrapped with quarter-inch asbestos bound with wire. This would prove reliable and inexpensive.

It is a fact, showing how common is the neglect to cover iron with non-conducting material, that in the State Capitol, Albany, N. Y., in the library, is a large plate girder entirely exposed. This girder supports the ceiling beams, and there is enough combustible material in the oak bookcases, furniture, and flooring to wreck this portion of the building by expansion in case of their combustion. The New

* "Shims" are pieces of slate or iron inserted to secure a true vertical where the two surfaces have not been properly leveled or planed.

York Building Law was enacted in this building. The ceilings of the Assembly and Senate chambers are of heavy, hard wood, attached to the soffits of the iron beams, and they would, if ignited, probably warp and expand the beams to a dangerous point.

A notable instance, showing the necessity of protecting ironwork with incombustible material, and the danger of expansion in long lines of iron girders or beams, was that of the destruction of a fire-proof spinning mill at Burnley, Eng., recently. This mill was 210 ft. long by 120 ft. wide, six cast-iron girders of the Hodgkinson type, each 20 ft. long, spanned the 120 ft. width, being bolted to cast-iron columns, and carrying, in turn, cross girders of wrought iron. The expansion of these 120 ft. girders (they were unprotected) resulted in the disruption of the floor and the destruction of the mill. The cast-iron columns, being unprotected, collapsed under fire and water. The floors were 10 ft. 6 in. bays. As already stated, beams should not be spaced over 5 ft. on centers. Wider spacing results in weak arches, liable to be buckled out by heat or punched through by the falling of safes or of other heavy articles from upper floors.

The probability is that if the 20 ft. girders in this building had been arranged with provision for expansion, and all the ironwork had been thoroughly protected with fire-proof material, little damage would have been done. The effect, if the floors had been loaded with combustible merchandise, would have been more rapid. There was little wood to burn in the contents of the spinning mill, and yet the destruction was thorough. Such buildings with uncovered ironwork are more dangerous than those of heavy wood construction, in which the timbers are 12 ins. or more in diameter, and not more than five stories in height. A properly constructed building with protected iron, however, is, of course, superior to any other form of building. Experienced firemen are afraid to enter buildings supported by iron columns unless they are thoroughly fire-proofed, as they are liable to snap without warning under the influence of fire and water, whereas wooden posts burn slowly and give notice of collapse. They will stand a severe fire without being charred for more than 2 ins. of their surface.

BEAMS AND GIRDERS.

In mercantile buildings and factories beams, as already stated, ought not to be spaced more than 5 ft. apart, no matter what kind of arch is employed; and while many experts claim that a heavy iron I beam, thoroughly encased in fire-proof material on three sides and having only its soffit or under side exposed, would not be expanded enough by the heat of a fire to cause its collapse, it is best to take no chances, but to protect the under side with fire-proof material, which can be cheaply applied with wire lath and plaster, or by having the skew-backs of the terra-cotta floor fillings extend below the soffit or bottom flange of the beam, and made with lips for protecting the iron.

TIE-RODS.

It is a mistake, in my judgement, to dispense with tie-rods, even with the kinds of arches which employ wire cables or other metal ties. The claim is made that these act as tie-rods, but it should be remembered that they cannot be relied on during construction, when derricks for hoisting iron beams and other materials are resting on the girders. Dangerous lateral movements and twistings of the structure may be the result of want of rigidity, which can only be secured by tie-rods.

MATERIAL FOR ARCHES BETWEEN BEAMS.

It is my opinion — but there are many who entertain a different one — that the old-fashioned brick arch is the most reliable for resisting fire; that next to this in safety stands the porous terra-cotta segmental arch, with end construction, *i. e.*, the blocks or separate pieces placed end to end between the beams, instead of side by side in what is known as "side construction." This is said to be stronger than side construction. It is claimed by many experts that porous terra-cotta is a better non-conductor than brick on account of its interior air spaces. The arch should not be less than 4 ins. thick, having a rise of at least 1¼ ins. to each foot of span between the beams, and there should be a covering of good Portland cement and gravel concrete over this to ensure a waterproof floor. Cinder filling will burn — crushed slag from blast furnaces is better, but the Portland cement concrete should not be omitted for waterproofing purposes.

There are many patent floor arches for filling between I beams which have great merit when properly put in, but I doubt if any of them are equal to the two I have named, and it should always be borne in mind that when employed they should be inserted with the same care with which they are prepared for tests. This is almost equally true, however, as regards brick and burnt-clay arches, also. There is less likelihood of poor installation work, however, with brick arches or segmental arches of porous terra-cotta or burnt clay. Arches should be laid in Portland cement, not lime mortar. Under no circumstances should they be laid in freezing weather, and where concrete is used the broken stone or gravel should be carefully washed, and the cement should be of the best quality.

WATERPROOF FLOORS.

It is of great importance that the floors of all buildings should be waterproof, in order that the volume of water thrown by the fire department to extinguish a fire may be carried off without injury to merchandise on the floors below. Neglect of these precautions is criminal in view of their simplicity and inexpensiveness.

After the arches have been set between the I beams they should be covered, for at least a thickness of 1 in., with the best Portland cement concrete, carefully laid, so that all water will run to the sides of the building and be carried off by water vents or scuppers, which may be arranged with pipes through the walls, having a check-valve which would prevent the influx of cold air and yet admit of the outflow of water.

All ducts for carrying steam, gas, and other pipes and electric conduits should be protected with a metal sleeve going above the surface of the floor, and the space between and around the pipes should be filled in closely with mineral wool, asbestos, or some other expansive and fire-proof material to cut off drafts and flame.

FLOOR SURFACES.

Floor boards should be dispensed with, if possible, and asphalt or concrete employed instead. It is hardly practicable in office buildings, however, to dispense with wooden floors. Wherever used they should be so laid, especially in mercantile or manufacturing buildings, that there is no air space to supply a passage for flame and to form a harborage for rats and mice, to which these vermin can carry matches, oily waste, or other combustible material, to be ignited by steam pipes or by spontaneous combustion.

FIRE-PROOFING WOOD.

Various processes, "electric," so called, and otherwise, have been patented for fire-proofing wood. They undoubtedly increase the fire-resisting properties of wood for interior trim, window casings, etc. Whether or not they impair the durability of wood is a matter as to which I am not yet informed, and I doubt if sufficient time has elapsed for a proper test. The United States Navy has made trials of fire-proof woodwork — with what success I am not informed.

VENTILATING AND LIGHT SHAFTS, DUMB-WAITER SHAFTS, ETC.

The enclosures of all ventilating shafts, for water-closets, etc., light shafts, and dumb-waiter shafts should be constructed in the same substantial manner as freight elevator shafts. It is a mistake to use thin plaster board or plaster with dovetailed, or other metal, lath, etc. No enclosure should be relied upon less than 4 ins. in thickness, well braced with angle iron, but brick walls are best, especially in buildings over 60 ft. high. The lights should be of wire glass, set in metal framework, and ventilators should have metal louvers arranged to secure ventilation but not to increase a draft. Slats should be riveted, not soldered, to metal framework, and the metal framework should

flange well over the fire-proof material of shaft on both sides. It is possible to finish tin-covered fire-proof doors with wooden trim so as to be ornamental, with bead panel-work, etc.

WELL-HOLES.

These should be avoided if the building is to be regarded as fire-proof. The Horne Building had one 48 by 22 ft. It is almost impossible to control a fire starting in the lower floors where a well-hole opens through those above. Luxfer Prisms are now used to secure light from side windows, it is claimed, with great success.

A recent fire test of the Luxfer Prism, in Chicago (March, 1898), is stated to have been satisfactory to Fire Marshal Swenie, as showing that these prisms afford material protection from the heat of a neighboring fire in an exposing building, and that to some extent they are substitutes for iron shutters.

STAIRCASES, ELEVATORS, ETC.

These should be in hallways cut off from the rooms at each story by fire walls and doors, to prevent drafts. It is not so important, and is not so practicable, in the case of office and hotel buildings as in the case of mercantile and manufacturing buildings; but it is advisable, even in office buildings, to have the staircases, elevators, etc., in a separate hallway, the division walls of which should extend through and above the roof, and any skylights should be covered with glass not less than ¼ in. thick.

SKYLIGHTS.

It is contended by some that skylights should be of thin glass, so that they will break easily and permit the escape of smoke and gas. Smoke is ignitible, and when it accumulates in a building often spreads the fire from story to story, or blows out the walls by the explosion of its gases. But while thin skylights are contended for by many expert firemen, it should be borne in mind that nothing so facilitates the spread of fire as a draft, and it would be better to have the skylights adjusted with appliances for opening them, so that when the firemen arrive on the ground, and not before, they may be adjusted to permit the escape of smoke and allow the firemen to enter the building to see where to work to the best advantage. Under any circumstances a network of wire should be above the glass to guard it against flying embers, and another should be suspended beneath the skylights, so that when the glass cracks and breaks with the heat it will not injure the firemen below.

ROOFS.

These should be of brick or tile on all high buildings, the roof beams being of iron and, where tanks are supported, of sufficient strength to carry many times the actual probable weight of the water and the containing tank itself.

SLATE ROOFS.

Slate roofs, on very high buildings especially, on street fronts are objectionable, as, in case of fire, the slates would crack and, falling to the street, injure the firemen. A flat roof of brick tile is better than any other.

All water on roofs from rain or melting snow should be drained from the front or sides to leaders, so as to avoid drip points, from which icicles could be formed. Too little attention is paid to the great danger of injury to pedestrians from falling snow or icicles on very high buildings. This may not be a suggestion strictly germane to this article, but it is a matter so often overlooked as to warrant its being referred to in an article intended to deal more or less thoroughly with the subject of fire-proof buildings.

ELECTRIC LIGHT INSTALLATION, DYNAMO ROOM, ETC.

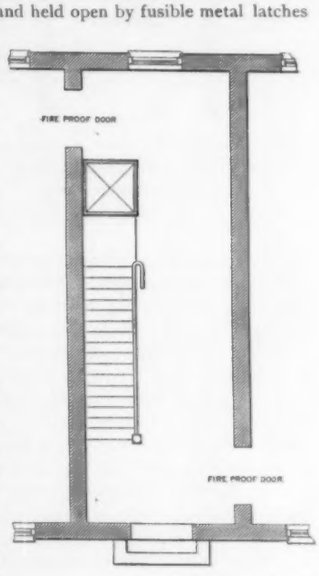
The electric light installation of a large fire-proof building is an important and complicated matter. To insure safety, reference should be had to the rules of the National Board of Fire Underwriters, which can be obtained, without charge, from the nearest local board of underwriters.

The switchboard should be of incombustible material, and no steam, water, or sprinkler pipes should pass over or near it where, in case of a bursting pipe, water could reach the switchboard and cause disaster. This is an important matter almost universally overlooked.

An admirable floor for a dynamo room is one of deck glass, ¾ in. thick, on a wooden (not iron) frame. It will insure that the attendant upon the dynamos will be, at all times, effectually insulated. Such a floor will not become soaked with oil, as would a wooden floor, and can easily be kept clean. A strip of rubber floor carpet stretched over it will prevent slipping. The Continental Insurance Company has, probably, the only floor of this kind in the country in its large fire-proof office building on Cedar Street, New York.

COMMUNICATIONS BETWEEN ADJOINING BUILDINGS.

It is sometimes necessary to have communications between adjoining buildings by doors in the fire walls, and it is not always convenient, for changing merchandise from one room to another, to have fire-proof doors closed during working hours. It is possible to have the fire-proof doors run upon trolleys on an inclined track so as to close by the force of gravity, and held open by fusible metal latches or links which would release them when melted by the rising temperature of a fire. It has occurred to me that this difficulty may also be met by erecting between two adjoining buildings a separating fire-proof hallway of brick, which can be utilized for containing staircases and elevators, and for supporting the water tanks of automatic sprinklers. The doors which open into this hallway should not be opposite each other, but at opposite ends of it, so that fire in one of the buildings passing through the door would come against a blank wall opposite. Even if the fire-proof doors to these openings should happen to be open at the time of a fire in one of the two buildings, it is improbable that it would find access to the other.



SEPARATING FIRE-STOP HALLWAY. GROUND PLAN.

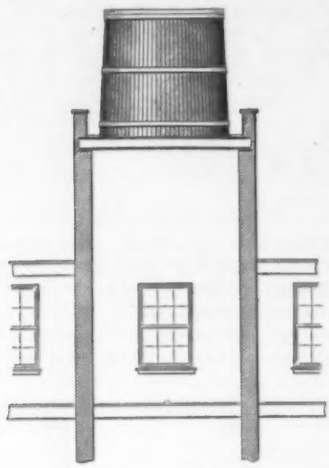
The floors should be both fire and water proof, slightly lower than those of the two separated buildings, and with water vents or "scuppers" for carrying off surplus water thrown by a fire department. Indeed, it is well to have "scuppers" on all floors of every building.

The walls of this separating hallway or vestibule should rise 4 ft. higher than the roofs of the two buildings, and, if there are window or door openings near it, its walls should project beyond the line of enclosing walls at least 1 ft. The following diagrams fully illustrate the idea.

The water tank, as already stated, should be supported on protected iron I beams, resting on the brick walls, with cast-iron templates, so that the tank cannot fall, break down the staircases and wreck the building in case of fire.

It is important always to locate tanks so that they will not be over stairways or elevators and endanger them in case the supports give way. With a fire-proof hallway of the kind recommended, containing no combustible material whatever, the tanks being supported by iron I beams resting on the brick walls, this would not be an important matter, but in all other cases water tanks should be planned so as not to endanger staircases, and the supporting iron beams should be fire-proofed, that is, covered with fire-proof material.

It ought to be unnecessary to state that there should be no combustible material whatever in this separating hallway, and that the staircase, elevators, etc., should be of metal and fire-proof.



SEPARATING FIRE-STOP HALLWAY — ELEVATION OF UPPER STORY AND ROOF WITH WATER TANK.

SEPARATION OF WOODEN BUILDINGS.

Indeed, such a hallway as this could be relied upon to separate wooden buildings. It should, however, for that purpose, be at least 10 ft. higher than the peak of their roofs and should extend 4 ft. beyond their front and rear lines. It is probable that the extensive frame dairy buildings of ex-Vice-President Morton at Ellerslie, which burned several years ago, might have been saved by this simple precaution.

OUTSIDE STAIRCASES.

Where it is not necessary to transfer merchandise from one building to another and only requisite to have a passageway for employees, this may be arranged by an iron balcony, like a fire escape, cutting down the window on each side of the separating wall for a door, so that communication can be had by the balcony. The openings should have fire-proof doors. This would be practically safe. It might, with iron ladders, be utilized as a fire escape, and so prove of great advantage to firemen in fighting a fire, who could hold a hose nozzle at the different windows with perfect safety to the last moment. It is practicable, indeed, to have iron stairways with roofed balconies entirely outside of storage stores so that the floors do not communicate. There is a number of these in Philadelphia.

FIRE-PROOF DOORS AND SHUTTERS.

These should not be of iron, but of wood covered with tin. Solid iron shutters or doors are not reliable. Iron doors yield readily to flame, resulting sometimes in their warping open when exposed to fire in an adjoining building, exposing the one they are intended to protect to the full effect of the flames.

Where window openings are protected by iron shutters on rear courts they are almost certain to be opened by a fire in an exposing building, and cannot be relied upon. The tin-covered wood shutters are alone reliable. There is no recorded instance in which a solid iron door, exposed to the full effect of fire in an adjoining building, has protected the opening, whereas there is, on the other hand, no recorded instance in which the "Underwriters'" door has failed to serve its purpose — two important facts which are significant and ought to settle the question.

The "Underwriters'" door is constructed of ordinary white pine lumber, free from knots, of double or treble thickness, according to width of opening, the boards being nailed diagonally and covered with the best quality of tin, with lap-welded joints.

It ought to be unnecessary to state that on the exposed side of a building, not only the shutter, but the window-frame, sash, etc., should be of metal or covered with metal — riveted, not soldered. Where it is not possible to use a fire-proof shutter for want of room, wire glass in a metal frame will be found a desirable substitute. It will probably hold a fire until the fire department can cope with it.

It is not generally understood or known that fire will travel from one story to others above by way of the windows in the outer or enclosing walls. Especially where a building has an enclosed court it will sometimes reach upper stories in this way, even when the floors themselves are thoroughly cut off, the court acting as a chimney. This happened several years ago in the Temple Court Building, a fire-proof structure in New York. The woodwork on several floors was ignited by the lapping of fire through the windows from the lower stories and serious damage resulted. A recent instance was the Livingston Fire-proof Building in New York, in January, 1898. All windows on exposed sides should be protected with fire-resisting shutters.

It may be well to suggest for the benefit of those who are not familiar with city fires that, as heat naturally ascends, the exposure of a low building is often much greater to a neighbor higher than itself than to a building of its own height, so that a tall, fire-proof structure, surrounded by smaller buildings, should be provided with fire shutters to all openings. These are not necessary where the exposing buildings are occupied for offices, and are themselves fire-proof, as the amount of heat which escapes from the windows of a burning building, so long as its enclosing walls remain intact, is seldom sufficient to ignite a fire-proof building or its contents. The moment of greatest danger is when a burning building collapses and the intense heat caused by its enormous bed of coals exerts its full effect upon surrounding structures. In a recent fire in New York (Feb. 11, 1898), three fire-proof office buildings were more or less damaged with their contents, although many feet away from the burning building.

It is to be hoped that some inventive genius will devise a plan for simultaneously opening or closing the shutters on any or all stories of high buildings by manipulation from the ground floor. They are usually left open at night, always in the daytime, and might thus be closed in case of a dangerous fire in the vicinity. In some cases they are fastened open.

COMPARATIVE TESTS OF FIRE-PROOF MATERIAL.

Tests of fire-proof material, iron beams, pillars, floor arches, etc., to be of any value must be conducted under circumstances which insure uniform conditions. Otherwise comparisons are unreliable. It is quite customary to refer to results of fires in different buildings, having differing forms of construction, as supporting theories of relative merit; but ordinary conflagrations cannot be relied upon, for the reason that in two buildings, side by side, the conditions may be widely different. Eddies and currents of air, changes of prevailing wind, etc., may secure exemption from damage. It happened in the large conflagrations of Chicago, Troy, Boston, etc., that the most phenomenal escapes were observed. In some instances frame buildings, surrounded by brick structures which were totally destroyed, escaped with no further damage than the blistering of paint.

Even where tests are carefully arranged, especially weight tests, obvious precautions are sometimes overlooked. It will be observed, for instance, where bricks are piled on a surface of floor arch and iron beams to secure a certain weight per square foot, the pile of bricks may be so disposed as to have a bearing on both of the iron beams and the full weight may not come upon the fire-proof arch between them. The lateral bond of a pile of bricks a few courses higher than the floor to be tested may have all the effect of a relieving arch and materially reduce the strains. In furnaces constructed to secure high temperatures, drafts and currents of air should be provided for with great care and under the direction of the most competent and intelligent experts.

In conclusion it may be well to state, in view of the general misapprehension which prevails with regard to the interest of the fire underwriter in the improvement of construction, that it makes no difference to him whether a building be fire-proof or not; his rate of premium and the amount which he insures are both based upon the characteristics of each building insured. He would make just as much money on $100 of premium secured at a rate of 5 per cent. for $2,000 insurance on a wooden planing mill as on $100 of premium secured on $100,000 insurance on a fire-proof building the rate of which is $1 per $1,000.

The Masons' Department.

THE CONTRACTOR AND THE REFEREE.

NEARLY all the standard contract forms which are used in formulating agreements respecting building operations contain a clause providing for settlements of differences between the owner or the architect and the builder, and although a very large share of power is of necessity conferred upon the architect, and the owner and the builder nominally agree to leave nearly everything to his decision, there is always reserved an appeal to supposedly disinterested referees. In theory a referendum of this sort is a perfectly fair way of settling differences. In practise, however, it fails very often because of the unwillingness of one party or the other to accept the results of the reference, and law suits follow with all their attendant evils. A law suit, at the very best, is an unsatisfactory way of settling differences. If the parties can only agree to finally agree, will only allow disinterested advice to prevail, and will then steadfastly refuse to reopen the question, a recourse to the courts need very seldom be resorted to. There is an opportunity for the master builders' associations throughout the country to accomplish a great deal, and win for themselves a large measure of prestige if they would use their already considerable influence to in some way enforce the value of a referendum, and to put themselves on record in such unmistakable manner that the decisions of the properly constituted board of reference would have the weight which theoretically the existing contract forms give to it. Some of the master builders' associations have already taken steps looking towards something of this sort. One of the largest of these parties recently had under serious consideration a by-law which provided for the appointment of a permanent board of arbitration, to which all questions which should arise, either between members or with members and some outsider, should be submitted for judgment, the association simply offering its good services, and standing ready to arbitrate between interested parties. Unfortunately, the builders who are honestly desirous of fair treatment, even if they are losers thereby, are always in the minority, while the number who feel they are free to do just as they please, who prefer independence of society control, and who claim the liberty to take advantage of every opportunity in their favor, rightly or wrongly, are always on the alert to head off anything which looks like a restriction of what they assume to be their rights. As a matter of fact, however, builders of this sort are the very ones who would profit most by a referendum. So long as the struggle for existence shall continue there will be more workers than there is work, and the minor builders, the ones with limited means, will be those who will have to take chances and are likely to be imposed upon by unscrupulous owners or by fraudulent subcontractors; and if they could lay all their troubles before a properly constituted board, with the assurance that they would be fairly treated, and would then have the courage to stand behind the award instead of rushing into the courts if the judgment goes against them, there is no doubt they would in the long run be vastly the gainers thereby. Indeed, the principle can and ought to be carried even farther. The master builders' associations are, as a rule, self-respecting, influential bodies, which can and should provide opportunities not only for peaceful arbitration of differences, but can go farther and make such arbitration obligatory upon their members both in the submission of differences and the acquiescence in the award, with the penalty of dismission from the body if the award is not accepted.

TESTS OF QUICK-SETTING CEMENT.

BY PROF. CECIL B. SMITH.

BECAUSE of the abuse which our quick-setting cements (the natural set of which may be in ten or twenty minutes) receive at the hand of careless or ignorant users by frequent retempering in order to use large batches of mortar extending over a period of several hours, the following tests were made: —

The proportionate reduction of strength would probably hold true for mortars as well as neat tests.

In the tests a large batch of mortar was mixed up and briquettes were molded from it. At the end of one hour the remaining mass had become appreciably stiffened and was retempered by adding sufficient water and by vigorous working. The same process was gone through each hour, but very soon the activity of the cement was so greatly killed that the setting would not take place for many hours, and very little extra mixing was required.

The "Quebec Natural," corresponding to such United States cements as "Cumberland," "Round Top," etc., has an incipient set of about 30 min. and a full set of 2 to 3 degs. The "Peacock Portland" is a sound, well-burnt, but coarse English cement, having an incipient set of about 20 min. and a full set of 1 to 2 degs.

	Quebec Natural.				Peacock Portland.			
	Time of Set.	Neat Tensile Strength per square inch.			Time of Set.	Neat Tensile Strength per square inch.		
		1 wk.	1 mo.	10 mos.		1 wk.	1 mo.	2 mos.
Original test . .	3 hrs.	157 lbs.	278 lbs.	520 lbs.	2 hours.	407 lbs.	515 lbs	596 lbs.
1st retempering	4 "	123 "	210 "	485 "	5 "	202 "	341 "	425 "
2d "	4 "	80 "	163 "	435 "	4 "	184 "	292 "	382 "
3d "	19 "	73 "	153 "	405 "	very slow.	185 "	365 "	388 "
4th "	19 "	52 "	157 "	380 "	"	.....	165 "	308 "
5th "	19 "	72 "	172 "	295 "	"	213 "	347 "	383 "
6th "	21 "	.....	173 "	270 "	"	180 "	310 "	402 "
7th "	.....	.....	.....	265 "	"	220 "	332 "	367 "

This table seems to point out two or three things rather clearly: —

1. That the first and second retempering do all the injury, the subsequent ones being merely the reworking of a mass which has not set.

2. That the strength of retempered cements is roughly one half of those not thus treated.

3. That time does not "heal all wounds," as the strength at ten months with the natural cement, and two months with the Portland, has not recovered to any very appreciable extent. This last deduction does not agree with the student thesis paper on the subject published about two years ago in the *Engineering News*, which claimed a recovery of strength in course of, say, six months.

I trust that such a memorandum as this will bring out some discussion on the matter from men whose experiences on the subject will be of value to the profession.

WALLING UP.

THE present manner of laying brick in dead walls gives one the impression that the quantity of bricks laid is of far more importance than the quality of the work done. The only way to obtain good solid brick walling is to either flush the joints solid with mortar every course or make a shove joint; the former method takes too much time and material, and the latter is very rarely done except in very heavy buildings. The custom generally adopted is to spread the mortar on the bricks (a portion only of which gets in the joints) and lay the bricks on top, each succeeding course being bedded in mortar; but the longitudinal and cross joints are only partially filled, the butting joint of the brick receiving a little dab of mortar gathered on the point of the trowel by cleaning the surplus mortar from the outside joint. Grouting with cement mortar every two courses in height might be adopted for basements and first stories of buildings when great strength is required. Full headers for face bricks are better than clippings and should be specified for all heavy buildings. The face bricks are often built up fifteen or twenty courses high before the backing up is done, a custom that should not be permitted, as it leaves the wall subject to many defects, as it cannot be well bonded or tied together sufficiently strong to be able to resist unequal strains successfully. For good strong work the mortar joints should never exceed five sixteenths of an inch in thickness.— *Canadian Architect.*

Brick and Terra-Cotta Work In American Cities, and Manufacturers' Department.

NEW YORK.— In spite of all the anxiety and uneasiness occasioned by our present foreign troubles, the New York building record is as follows:—

Total number of new buildings, January 1 to April 1, 715 as compared with 908 during the corresponding time in 1897.

Total cost of these buildings, $17,454,325. Cost of the 908 buildings during 1897, $19,342,550.

No very large or important buildings have been reported during the past month, but the general condition of work is good. Too much praise cannot be bestowed upon the new Washington Life Building, C. L. W. Eidlitz, architect. It is now nearing completion, and more than lives up to the promises conveyed in the drawings. The stone is of a beautiful soft color, the carvings are unusually well disposed, the fenestration is excellent, and it is altogether a success and one of our best office buildings. It is not on a prominent enough corner to do it full justice, however.

Among items of new work might be mentioned: Plans have been prepared by Henry M. Congdon, architect, for a new edifice for St. Mark's Protestant Episcopal Church, Brooklyn, to be erected on the Eastern Parkway near Nostrand Avenue; cost, $50,000.

A competition is now being held for designs for the new Franklin Bank. The only competing architects are Geo. B. Post, R. H. Robertson, and Lamb & Rich.

Plans have been filed by Clinton & Russell for the new eleven-story Cheseborough building. The materials will be brick and stone; cost, $430,000. The work of demolishing the old buildings upon the site has been commenced.

Quinby & Broome, architects, are preparing plans for a five-story red brick and white terra-cotta apartment and studio building to be erected at 83 Washington Place; cost, $30,000.

McKim, Mead & White, architects, are preparing plans for a twelve-story fire-proof office building to replace the "Nassau Chambers" recently destroyed by fire. The owner is ex-Governor Levi P. Morton.

Glover & Carrel, architects, of Brooklyn, are preparing plans for a seven-story brick, terra-cotta, and stone apartment house, 75 by 80 ft., fire-proof construction; cost, $80,000.

Architects Cady, Berg & See are preparing plans for the new buildings to be erected on West 15th and 16th Streets for the New York Hospital.

Work will be commenced at once upon the new building for the University Settlement Society. The cost will be about $90,000. Stokes & Howells, architects.

DETAIL, COMMERCIAL CABLE BUILDING, NEW YORK CITY.

The figure is 5 ft. 6 ins. high, located on the building at an altitude of 240 ft. from sidewalk. Executed in terra-cotta by the Excelsior Terra-Cotta Company. Harding & Gooch, Architects.

Plans are being prepared by Howard & Cauldwell for a new residence to be erected on the northwest corner of Park Avenue and 58th Street. It will be four stories and basement, 28 by 100 ft., with pressed brick and limestone front; cost, $50,000.

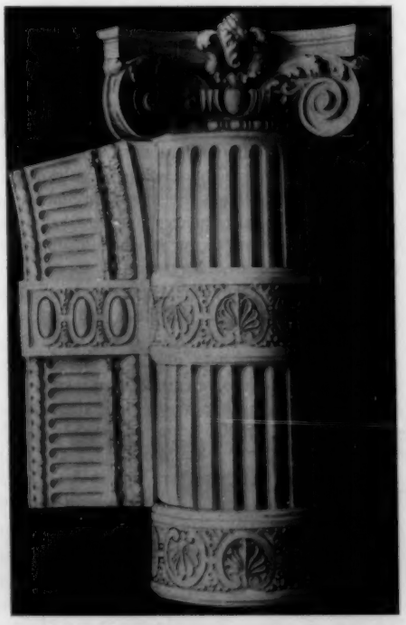
Architects Trowbridge & Livingstone are preparing plans for a five-story office building to be erected on Beaver Street for the American Cotton Oil Company. It will be a pressed brick and stone fire-proof structure; cost, $95,000.

CONSOLES TO DORMERS, COMMERCIAL CABLE BUILDING, NEW YORK CITY.

Executed in white terra-cotta by the Excelsior Terra-Cotta Company. Harding & Gooch, Architects.

CHICAGO.— The possibility of a war with Spain has had a noticeable effect on building projects. Capital has been inclined to hold back plans for new buildings until the uncertainty be ended. Aside from this factor in the situation, however, building operations are not as brisk as those interested would like to see them. Many architects have been reaching out into new territory for their business and they are hoping that their services will be needed more urgently here in Chicago next year than they seem to be this.

Architects and contractors in general seem to be in sympathy with the new State license law. More than seven hundred architects have paid in their twenty-five dollars each, and more than five hundred of these are in Chicago alone. Any shyster architect who could swear that he was practising when the law was passed had to be granted a license. But the commission has the power to prevent unworthy acquisitions to the profession in future, and the Architects' Business Association has taken up the matter in a definite way to assist the Commission or Board of Examiners and to prosecute violation of the law, which, while it allows to con-



TERRA-COTTA DETAIL, GRAMMAR SCHOOL NO. 7, BALTIMORE, MD.

Executed by the Conkling, Armstrong Terra-Cotta Company, Wyatt & Nolting, Architects.

tractors certain independent privileges in designing their own buildings, will not allow any one to call himself an architect or to give out plans for others to bid on unless he holds a license. The revision of the building ordinances just made by the Chicago Council forbids the granting of permits on plans for any building larger than two stories, and 1,200 sq. ft. in area, unless bearing the stamp of a licensed architect.

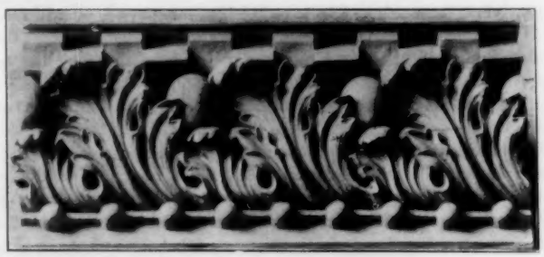
It is of interest to note that in the revised building ordinances referred to the Chicago aldermen have juggled again with height limit of buildings. A year or so ago the limit was reduced to 155 ft., now it stands at 130 ft., or practically ten stories as the limit of height for fire-proof buildings.

This, in the opinion of prominent architects, will discourage capital from investing in the best class of buildings. The aldermen who brought about this result represent the same public opinion which resents concentration of business and is fighting the department stores.

The annual architectural exhibition is the event at the Art Institute at the present writing. The showing was a large one, even though the quality was not uniformly the highest. The exhibits sent by Eastern architects and by the schools were good, but it seems that the most prominent architects of Chicago do not take as active part as they might. It must be that we need an Art League.

One of the interesting features of the exhibition was the work of the several groups into which the Architectural Club was divided last fall. Its particular *projet* was selected by each group, and the several drawings constituting a design (in one case a scheme for an elevated railway station) were the joint work of those in the group under the direction of their leader or "patron," himself a member of the club.

One noticeable feature of the exhibition was Dwight Perkins's design for one of the Omaha Exposition buildings, accompanied by



TERRA-COTTA STRING-COURSE, THE LENOX, BUFFALO, N. Y.
Executed by the Northwestern Terra-Cotta Company.
Loverin & Whelan, Architects.

models of the groups of statuary designed for the building by R. W. Bock.

In conjunction with the architectural exhibition there was held the first annual exhibition of the Arts and Crafts Society, an organization made up of artists, architects, people interested in social settlements, and others who are trying to raise the standard of artistic excellence in the arts and crafts. The exhibit, which included products in wood, metal, and fabric, from jewelry to furniture, was surprisingly good both in quantity and quality.

PHILADELPHIA.—The John Stewardson Memorial Scholarship has become the goal of the young architectural draughtsman's hopes here, even as its older fellows in Boston and New York have long been in those cities. It is now six years since the University of Pennsylvania Traveling Scholarship in Architecture was established, and though never funded, it has sent a student abroad for four consecutive years. The sudden death of John Stewardson created the desire among his professional coworkers, admirers, and followers for some tangible evidence of their appreciation of the high place he had reached, and of the good he had done towards the advancement

RESIDENCE, BEACON STREET, BOSTON.
H. H. Richardson, Architect.

of architecture. This culminated in their raising a fund sufficient to insure for all time the continuance of the yearly scholarship with which his name was then coupled.

The prize has just been competed for by ten men, the program of competition proving of unusual interest. One has become so imbued with the understanding that scholarship competitions consist of designs for crematories, opera houses, custom houses, imperial villas, etc., of the most strictly *beaux arts* type that to break away at one step to "A Farm Steading," as was done this year, seemed quite to upset all axioms relating to this class of competitive work. The jury, Messrs. Sturgis and Andrews, having been taken, previous to the award, through Delaware County, where the farm was supposed to exist, had ample opportunity to grasp the nature of the problem, and were enthusiastic in their praise of the schemes submitted. The successful man is William C. Hays; first mention, Arthur H. Brockie; second mention, John Molitor; third mention, Alfred M. Githens, all of whom it appears are draughtsmen in the same office in this city.

Work on a large building for the Philadelphia *Press* is about to be commenced at 7th and Sansom Streets, from plans by T. P. Chandler. Mr. Chandler has designed many of the down-town office buildings, but it is some years since his work lay in that direction.

TERRA-COTTA CAP, STATE NORMAL SCHOOL, PROVIDENCE, R. I.
Executed by the Standard Terra-Cotta Company.
Martinl& Hall, Architects.

This is to be an example of steel construction with facing entirely of terra-cotta, it being found more economical than brick.

Another large structure is in the office of Wilson Brothers, architects, to be put up for the newly founded gas company that has leased the city's gas works.

The old blue laws against Sunday work were invoked against the contractor for an office building at Broad and Chestnut Streets, the foundations for which are just being put in. It seems the necessary encroachment on the neighboring property for the purpose of underpinning the party wall was objected to by the tenant, so the wily contractor set to work after hours, on a Saturday afternoon, kept at it all night and all next day, and so had the thing completed by Monday morning, to the astonishment, if nothing worse, of the aforesaid tenant. The arrest for desecration of the Sabbath, which followed, had not much result,

BUILDING FOR S. FAITH & CO., PENN AVENUE AND TAYLOR STREET, PHILADELPHIA.
Hales & Ballinger, Architects.

TERRA-COTTA DETAIL, BLIND ASYLUM, OVERBROOK, PA.
Executed by the Burlington Architectural Terra-Cotta Company.
Cope & Stewardson, Architects.

as it was proved to the satisfaction of the court that the work was one of necessity.

ST. LOUIS.—Quite a little activity has been noticeable in building circles recently, and no small interest is felt in the prospects of some of the old landmarks recently destroyed by fire, to which reference was made in the February BRICKBUILDER, being replaced by modern fire-proof structures.

The G. A. Fuller Construction Company, of Chicago, have been awarded the contract for a twelve-story building on the site of the old Polytechnic Building, which they promise to have ready for occupancy by the first of the year. The contract is for $350,000, and the building is to be of brick and terra-cotta. Eames & Young are the architects.

Shepley, Rutan & Coolidge are preparing drawings for an eight-story fire-proof commercial building, on the corner of Broadway and Locust Street, to take the place of the old Mermod, Jaccard Building, and Isaac Taylor plans for a warehouse on 3d and Locust Streets.

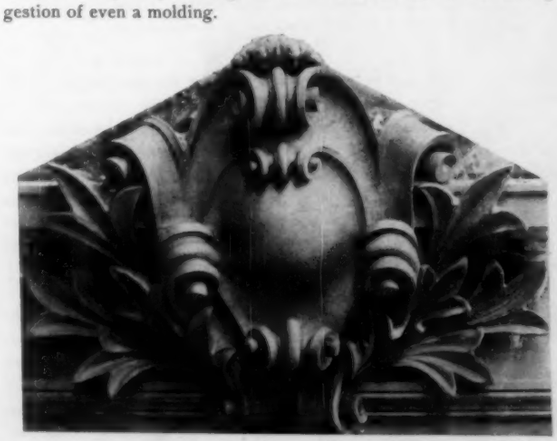
There are a number of other buildings in contemplation, but the anticipated war has caused some uneasiness in the money world, and negotiations have been suspended in some instances.

The Board of Trustees of the Public Library recently purchased the entire block between 18th, 19th, Olive, and Locust Streets, which will eventually be the location of the library. The building will not be commenced for several years, a proposition to levy a tax for that purpose having failed to receive the requisite number of votes at the last election, and it will be impossible to resubmit the matter for more than a year.

The methods of our school board were so unsatisfactory that the legislature, last winter, was prevailed upon to pass a bill reorganizing the same. Later an election was held, which resulted in the election of a non-partisan board, and Mr. Wm. B. Ittner was appointed Commissioner of Buildings. Mr. Ittner has just awarded the contract for five school buildings that prove of especial interest, they being the first to be erected under the new building ordinance, which requires all school buildings to be fire-proof, and the cost is less than similar buildings of ordinary construction under the old régime.

The exodus of the city officials from the old City Hall, which had been promised to occur on the 11th of this month, will be equally gratifying to the public and officials, as some encouragement is offered that we may eventually have a new City Hall, even if it does become old before it is finished.

The building was commenced during the summer of 1890, after plans had been selected in a competition not devoid of criticism. After numerous delays incident to work of a public character, the north and south wings have been so far completed that they may be occupied; but the central portion, which includes the two chambers of the municipal assembly and rotunda, are still to be finished. The city has been handicapped by the meagerness of the building fund, and have been compelled to practise the strictest economy in finishing the building, which in many cases might be open to criticism. This is particularly noticeable in the corridors and stairs. The original scheme doubtless contemplated something elaborate, as the ceilings are coffered and richly ornamented, but the walls have been finished with plain plastering and Tennessee marble, without the suggestion of even a molding.



TERRA-COTTA DETAIL, NEW YORK & NEW JERSEY TELEPHONE BUILDING, BROOKLYN, N. Y.
Executed by the Perth Amboy Terra-Cotta Company.
R. L. Daus, Architect.

TERRA-COTTA LINTEL.
Executed by the New Jersey Terra-Cotta Company.

MEMPHIS. — Contrary to the prediction of calamity howlers and those who considered Memphis doomed after the yellow fever scare of last fall, the building outlook for spring and summer '98 is exceptionally good. Soon after what at first promised to be an epidemic an extra session of the legislature was called and the limits of the city extended, certain bills being passed to enable the authorities to sewer the annexed districts, also a certain portion of the old city where the fever wrought the greatest havoc.

As proof positive that confidence has been restored, it is only necessary to call attention to the clearing-house receipts for February, which aggregated nearly twelve millions of dollars, or more than the combined receipts of Nashville, Tenn., and Atlanta, Ga.; or more than Nashville, Knoxville, Chattanooga, Jacksonville, and Birmingham combined — an increase in Memphis receipts of more than 60 per cent. over February, 1897. Every precaution known to science in the way of sanitation is being taken to safeguard Memphis in the future, and, even if brought here, there will be no possible chance of the dreaded disease spreading.

Ground will be broken in May for St. Mary's Cathedral, to cost several hundred thousands of dollars. Work has already begun on the new Poplar Street School — contract $100,000 — and a syndicate has been formed to build a ten-story hotel. There is also a substantial rumor that in addition to the City Hospital buildings and Market House just completed, the new city administration will build a new City Hall.

Memphis architects are nearly all busy with Mississippi work, which is the most promising field in the South for architects. There is a vast improvement shown in the character of buildings under course of construction, and also some degree of attention is being paid to design, probably due to the influence of Eastern competition.

NEW TRADE PUBLICATIONS.

THE CLEVELAND HYDRAULIC-PRESS BRICK COMPANY has this season issued an elaborate copyrighted publication entitled "Early Religious Architecture of America," containing thirty plates 14 by 17 ins. in size, illustrating subjects especially selected by the company, of the ancient missions and churches of America. The work is a distinct departure in the line of advertisement. Indeed, except for the modest title page and the single advertising sheet at the end, the work would be taken to be a professional publication issued under the direction of an architect who was not only competent to make a wise selection, but was by training and experience enabled to know what to choose. The plates reveal a phase of American architecture which has been appreciated to a certain extent by some of our architects, and yet we imagine to many of them the quality of the work here shown will be a very considerable surprise. The best of the buildings are naturally from Mexico. Indeed, only a few are found within the borders of the United States. The cathedral at Chihuahua, and the work at Aguas Calientes are especially interesting for their architectural merit. The plates are accompanied by a very complete description of the several edifices together with a considerable amount of historical data relating to them. Altogether it forms a publication which will be welcomed by every architect and which ought to be eagerly sought for. This issue is by the Cleveland Company, and though all of the Hydraulic-Press Brick Companies are to a certain extent affiliated and will undoubtedly indirectly profit by whatever advertising would result from this publication, it is a distinctive product of the Cleveland Company, to whom great credit should be given for the excellent manner in which it has been gotten up and for the evident intent to not merely produce a good advertisement, but to publish a book which shall be of distinct worth and interest to every one who has in mind the value of American architecture.

THE ATWOOD FAIENCE COMPANY, of Hartford, Conn., has published an interesting portfolio illustrating a number of the mantels which the company is prepared to furnish in stock patterns in enameled terra-cotta. The plates form a collection which will be of value to those who contemplate the use of such product.

CURRENT ITEMS OF INTEREST.

A LARGE quantity of enameled tiling will be done in the new Town Hall at Revere, Mass., the Grueby Faience Company furnishing the tiles.

THE OHIO MINING AND MANUFACTURING COMPANY, makers of the Shawnee Brick, are represented in New York City by Meeker, Carter, Booraem & Co.

Mr. F. P. PLUMRIDGE, formerly connected with the Hydraulic-Press Brick Company at St. Louis, has associated himself with the Evens & Howard Fire Brick Company of the same city.

DYCKERHOFF PORTLAND CEMENT is used in the new Union Station platforms at Providence, R. I., a job of considerable size, and also in the sidewalks around the State House, Boston.

THE C. P. MERWIN BRICK COMPANY, Berlin, Conn., are supplying the hollow bricks which are being used in Southern Terminal Station, Boston, also the new State Capitol building at Providence, R. I.

THE Celadon roofing tiles have been specified on the building for Mrs. Cole, Copley Square, Boston, of which Dwight & Chandler are the architects. The Celadon Company is represented in Boston by Charles Bacon.

THE PANCOAST VENTILATOR COMPANY are supplying their ventilators for a large government building at Fortress Monroe; Empire Building, New York City; and new round house for the Baltimore & Ohio Railway.

THE BRICK, TERRA-COTTA & SUPPLY COMPANY, Corning, N. Y., have the contract for furnishing the architectural terra-cotta required for the Kaufman building to be erected at Pittsburgh, Pa., Charles Bickel, architect.

THE GRUEBY FAIENCE COMPANY have been awarded the contract for furnishing the tiles for the walls of the restaurants in the new Southern Terminal Station, Boston. They are to be like those used in the Boston Subway stations.

THE EVENS & HOWARD FIRE BRICK COMPANY have closed contracts for supplying 200,000 face brick for the Chicago, Milwaukee & St. Paul Railway Passenger Station at Minneapolis, Minn., Charles S. Frost, of Chicago, architect.

THROUGH their Boston representative, Charles Bacon, the Excelsior Terra-Cotta Company will supply their terra-cotta for the new Mattapoisett School, Charles Brigham, architect, and for the new school at Malden, Mass.; Whitman & Hood, architects.

THE BERLIN IRON BRIDGE COMPANY designed and built the new buildings for the Morse Wool Treating Company at Norton, Mass., and have contracted for building a new power house, car

barn, and steel bridges for the Port Jarvis Electric Railway Company, Port Jarvis, N. Y.

THE CELADON TERRA-COTTA COMPANY'S roofing tiles have been specified on the following new contracts: Residence for William Henderson, Chicago (8 in. Conosera); railway stations at Atlantic and Iowa City, R. I. & P. Ry. (10 in. Conosera and open shingle); school building at Niagara Falls (10 in. Conosera).

E. P. LIPPINCOTT & CO., Baltimore agents for the Excelsior Terra-Cotta Company, have closed contract for supplying the architectural terra-cotta to be used on the new Columbia Law Building at Washington, D. C., and, as agents for the Pittsburgh Terra-Cotta Lumber Company, will supply the fire-proofing for the same building.

THE new Jordan Building, Boston, Winslow & Wetherell, architects, will be supplied with the Sayre & Fisher Company's bricks, through their Boston office. The same company will also supply the enameled bricks to be used in the new Masonic Building of which Loring & Phipps are the architects.

H. F. MAYLAND & CO., manufacturers' agents, New York City, are supplying the Roman buff and gray bricks for several apartment houses being erected in New York City and Brooklyn, for which W. B. Willis is the architect, and also the bricks that are being used in the residence of George Gould, Esq., at Lakewood, N. J., Bruce Price, architect.

THE COLUMBUS BRICK & TERRA-COTTA COMPANY are supplying their bricks on the following new contracts: Public school building, New York City, C. B. J. Snyder, architect; store building, Cincinnati, Ohio, Ball & Taylor, architects; residence, Newport, Ky., Dittoe & Wisenall, architects; parish house, Pittston, Pa., E. F. Durang, architect; residence at Detroit, Mich., Baxter & Hill, architects; Phœnix Block, Knoxville, Tenn., Baumann Bros., architects; stable at Omaha, Neb., Henry Ives Cobb, architect.

WE are in receipt of a very unique paper weight from the American Mason Safety Tread Company, consisting of a strip, some 4 ins. long by 2 ins. wide, of their safety tread. This is handsomely finished in brass and nickel, and forms a novel and attractive weight. Its broad, flat surface makes it particularly desirable for the draughting table, and it is the intention of the company to supply each architect's office with one or more of them as a means of keeping the American Mason Safety Tread and its merits actively before the attention of the profession. Parties desiring one of these paper weights should send their address to the American Mason Safety Tread Company, 40 Water Street, Boston, Mass.

A salesman with eight years' experience in introducing goods among the architects and builders in the territory east of the Mississippi to the coast, wishes to connect himself with a concern dealing in a line of building specialties. Best of references furnished.

Address, SALESMAN,
Care of THE BRICKBUILDER.

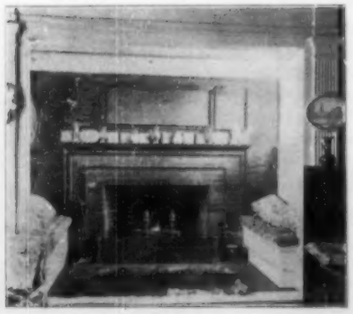
A party having several years' experience in selling building supplies in New England, and with an extensive acquaintance among the architects and contractors in the New England territory, desires to connect himself with some concern dealing in general building materials.

Address, C. M. J.
Care THE BRICKBUILDER.

For Sale.

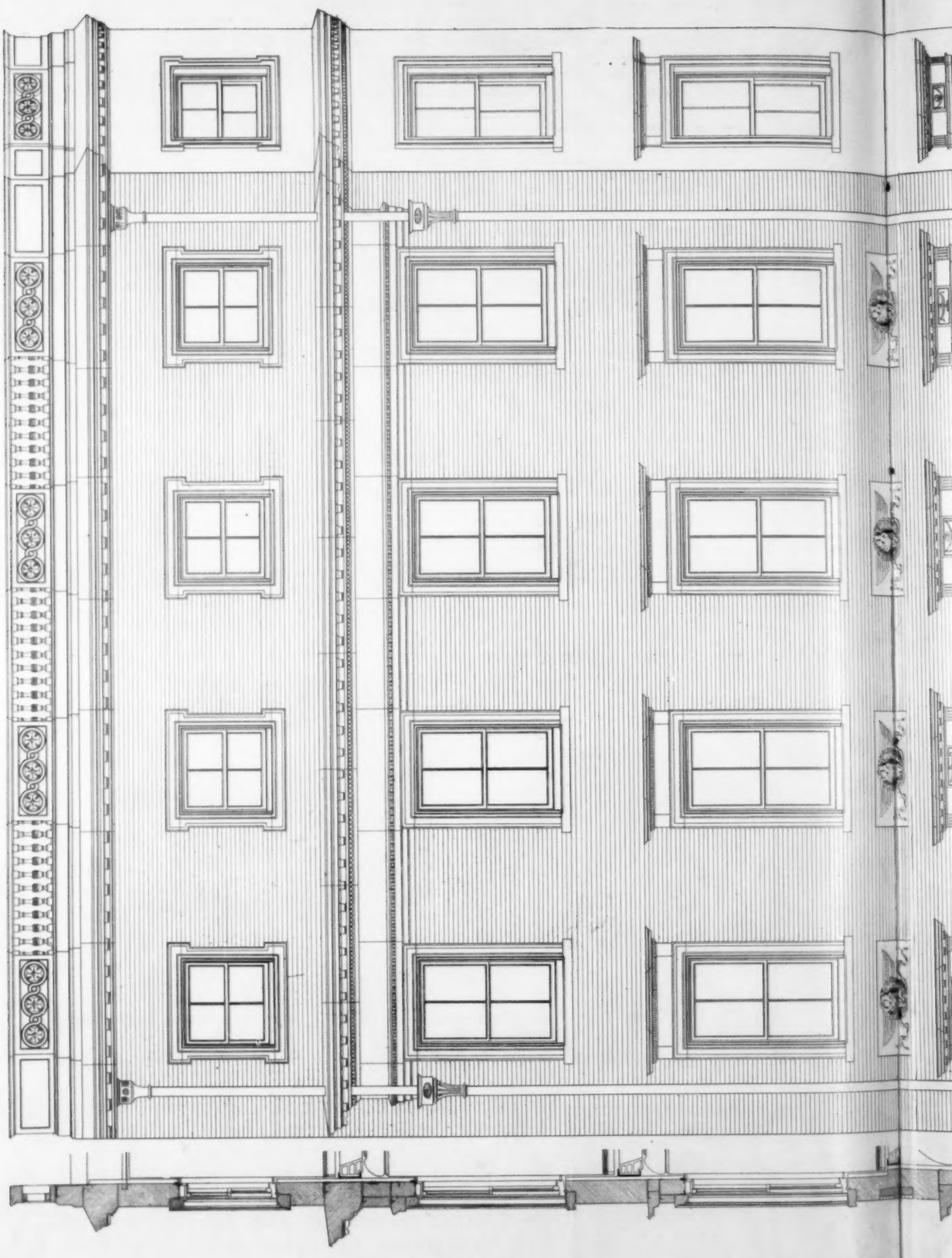
One of the largest and finest Clay properties in the States. The various clays are suitable for all kinds of manufacture in which clays are used. This is a good opportunity for an Eastern party who may desire to engage in the manufacture of all kinds of brick. The clays and base for fire bricks are the best in the country. The property is well developed. For full particulars apply or address, JOHN A. EAGLESON, 64 Irving Place, New York.

Fireplace Mantels.



The best ones to buy are those we make of Ornamental Brick. There's nothing else as good or as durable. Our mantels don't cost any more than other kinds, and are far better in every way—our customers say so. Don't order a mantel before you have learned about ours. Send for our Sketch Book showing 53 designs of mantels costing from $12 upwards.

Phila. & Boston Face Brick Co.,
15 LIBERTY SQ., BOSTON, MASS.



HOUSE OF E.W.BLISS ESQ.
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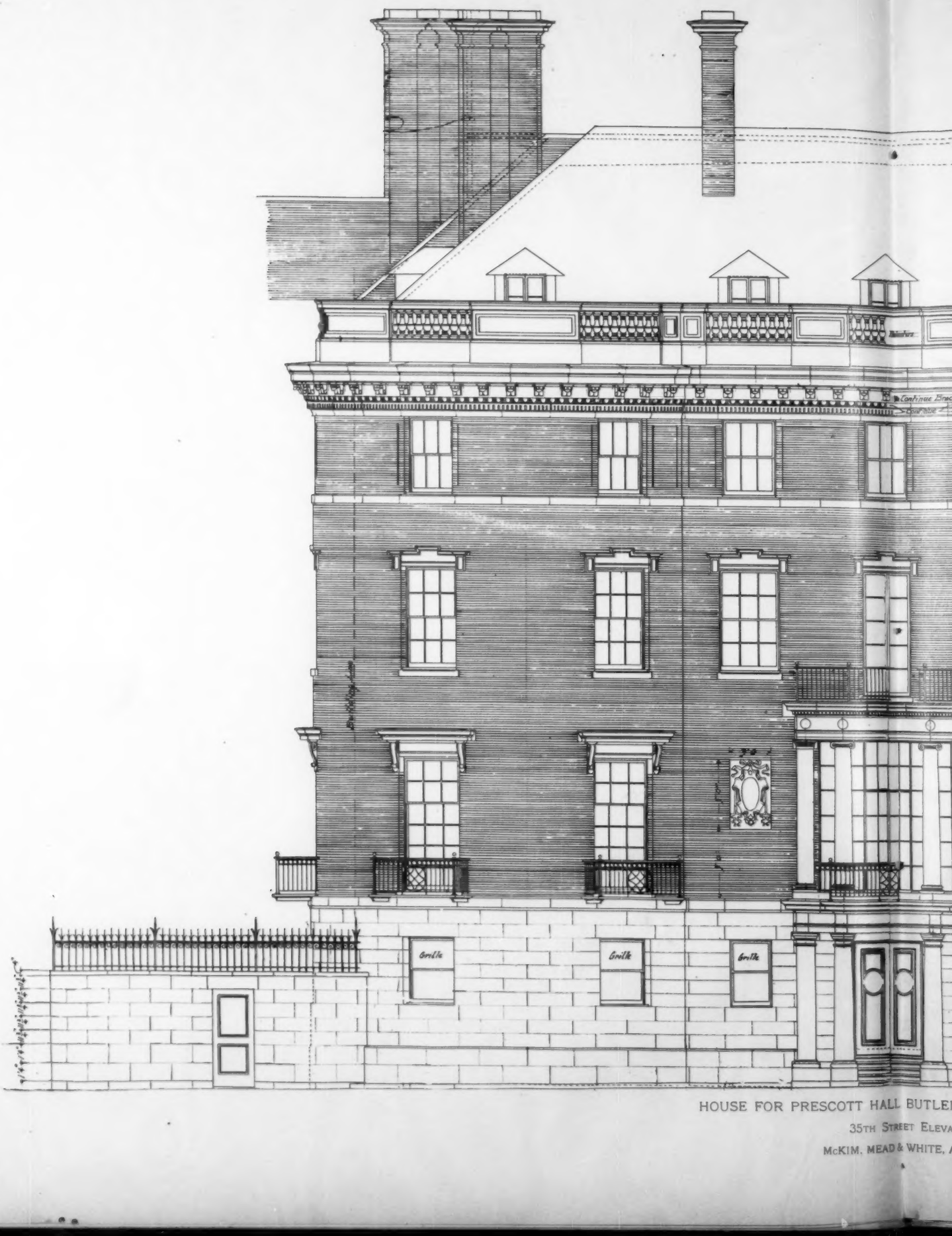
NEW YORK.
LITTLE & BROWNE ARCHTS
NO.11 BROADWAY NEW YORK
BOSTON OFFICE 70 KILBY ST.
PLAN



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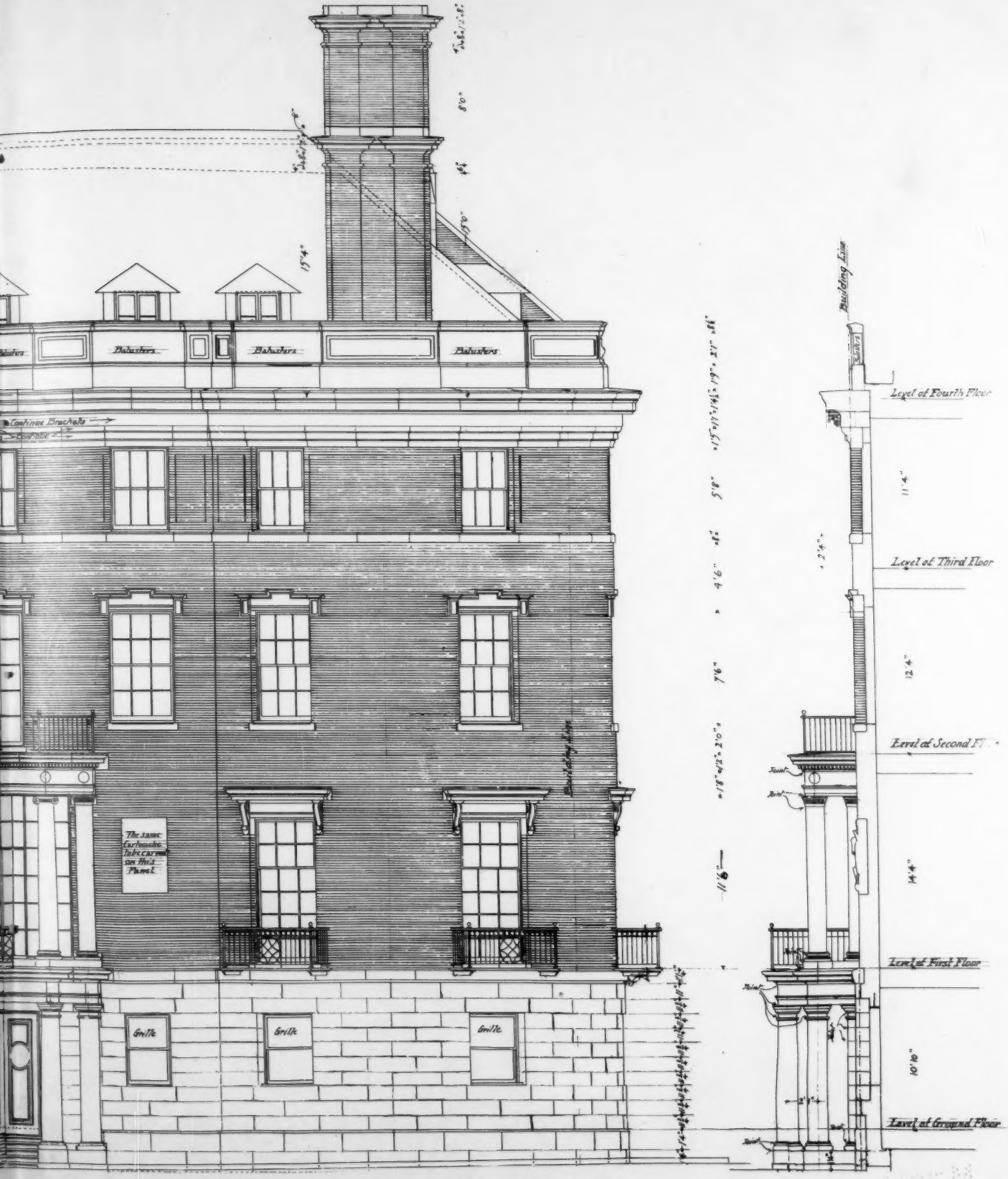
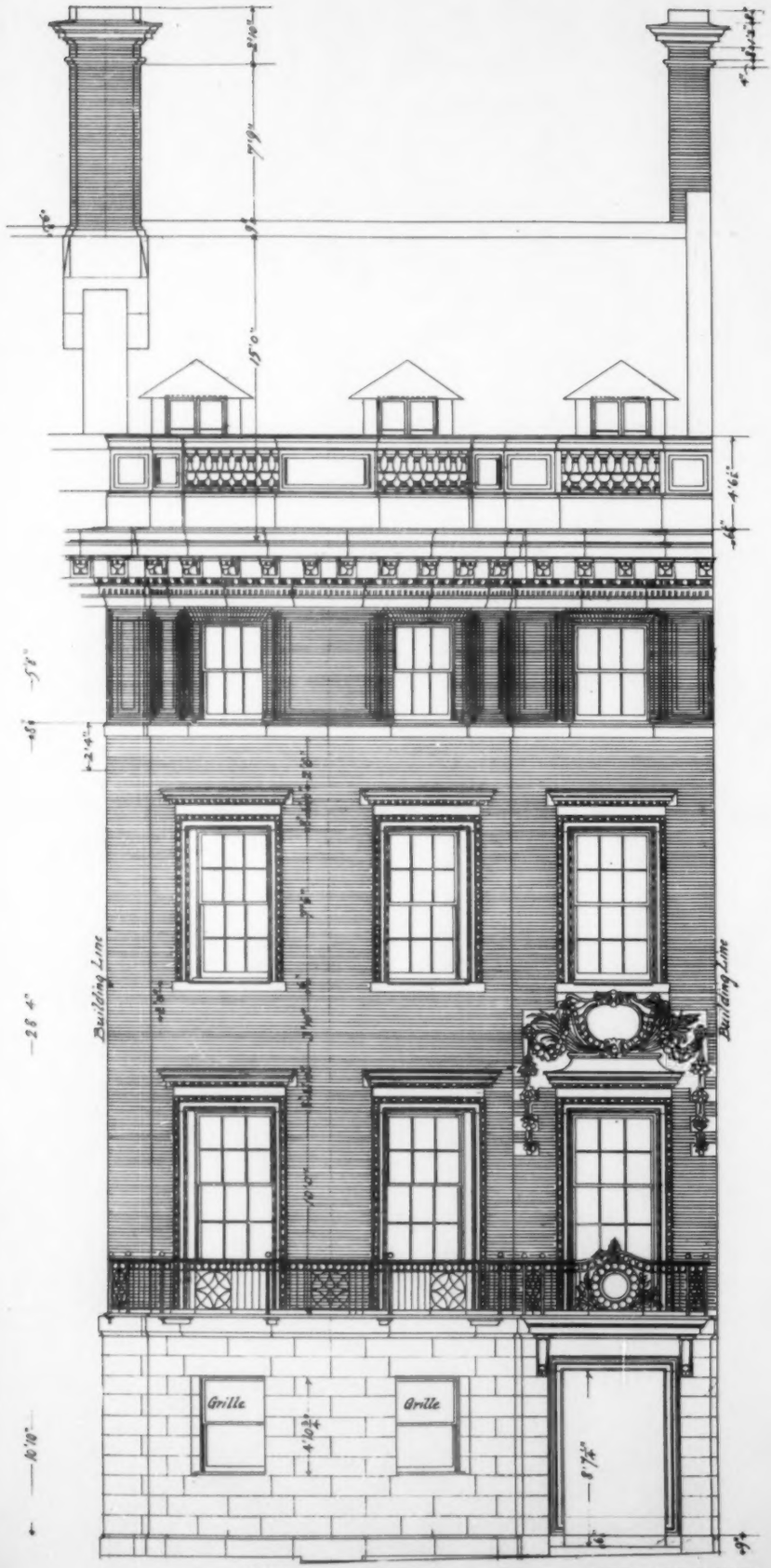


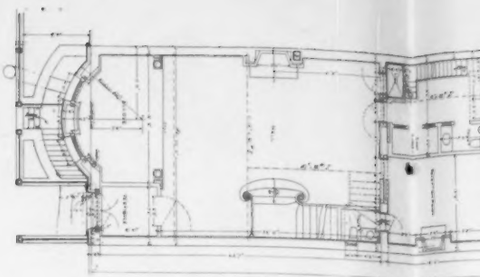
ALL BUTLER, Esq., NEW YORK CITY.

STREET ELEVATION.

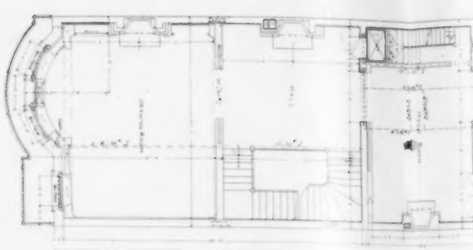
AD & WHITE, ARCHITECTS.



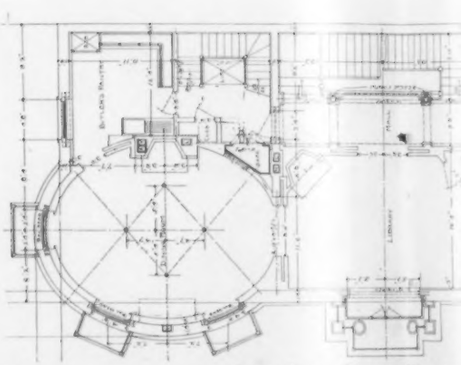
HOUSE FOR W. D. GUTHRIE, Esq., NEW YORK CITY.
PARK AVENUE ELEVATION.
McKIM, MEAD & WHITE, ARCHITECTS.



GROUND FLOOR PLAN. GUTHRIE



FIRST FLOOR PLAN. GUTHRIE



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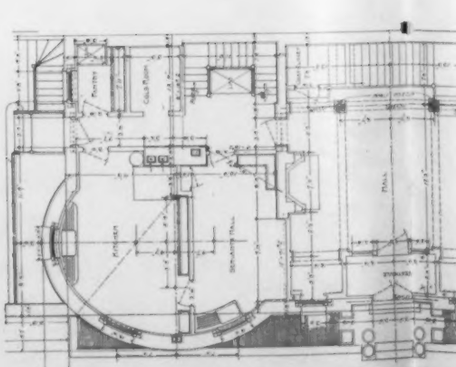

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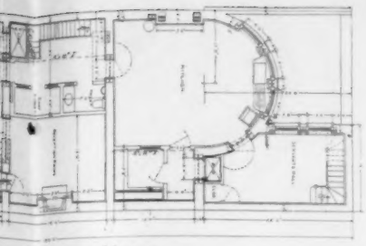

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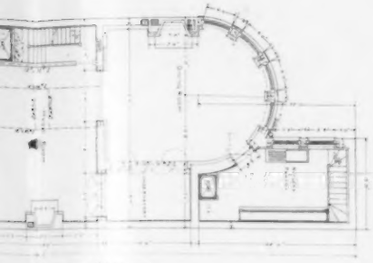

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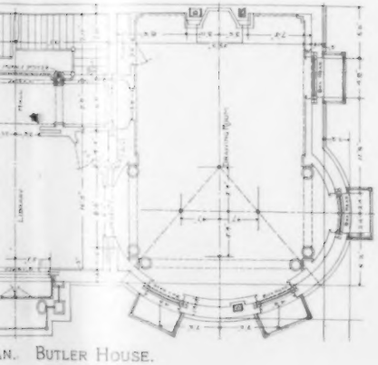
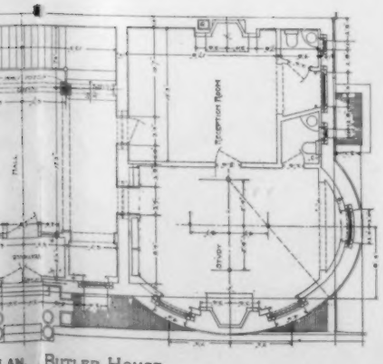
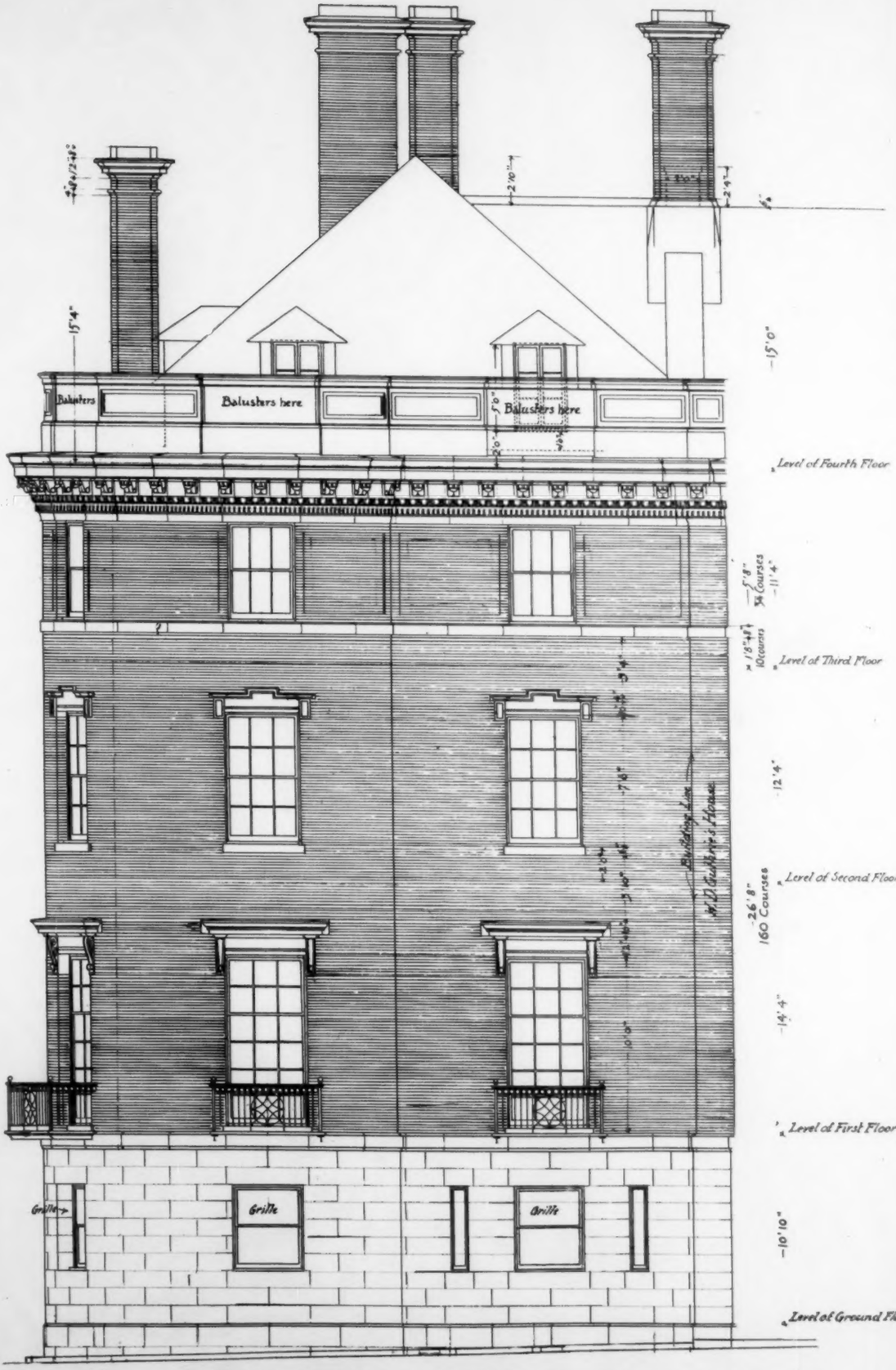


N. BUTLER HOUSE.



LAN. BUTLER HOUSE.

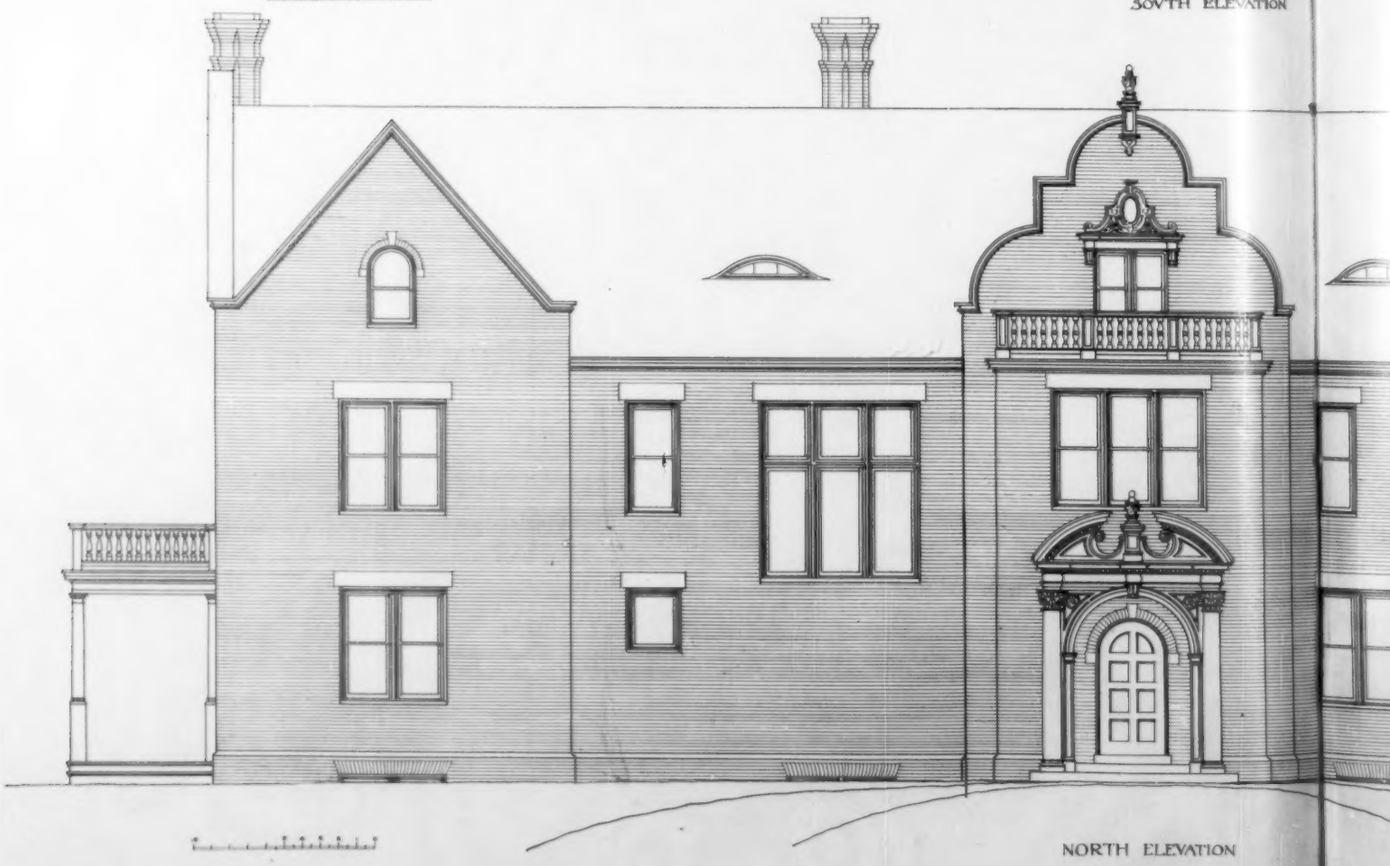


HOUSE FOR PRESCOTT HALL BUTLER, ESQ., NEW YORK CITY.

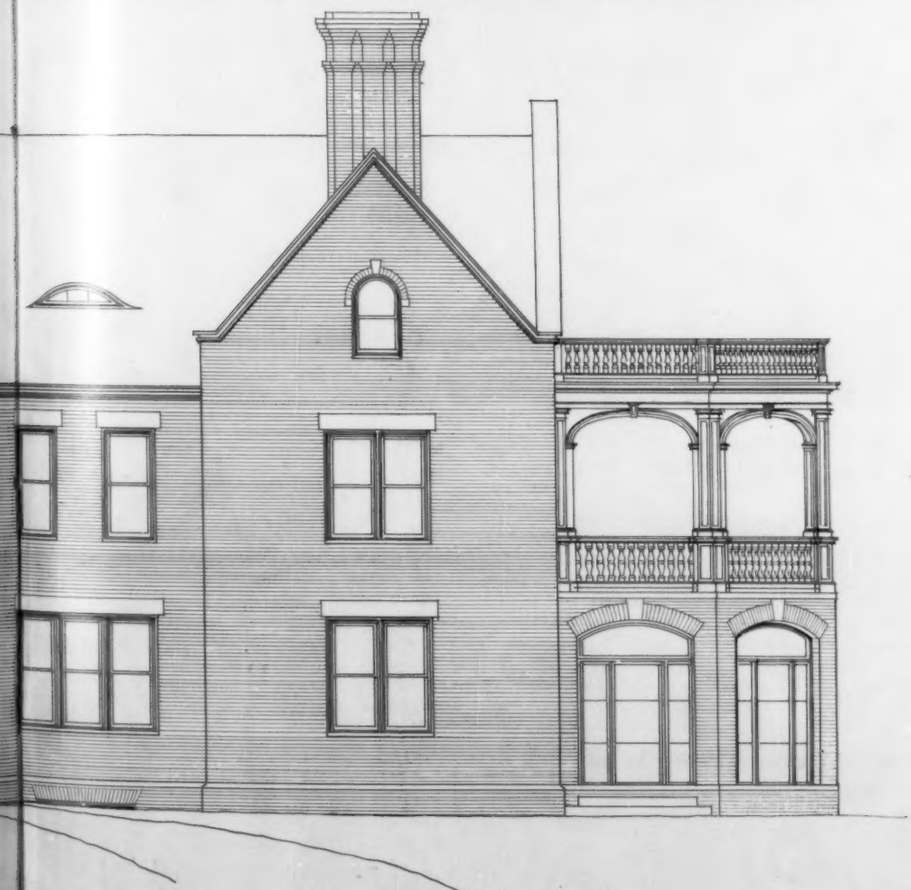
PARK AVENUE ELEVATION.

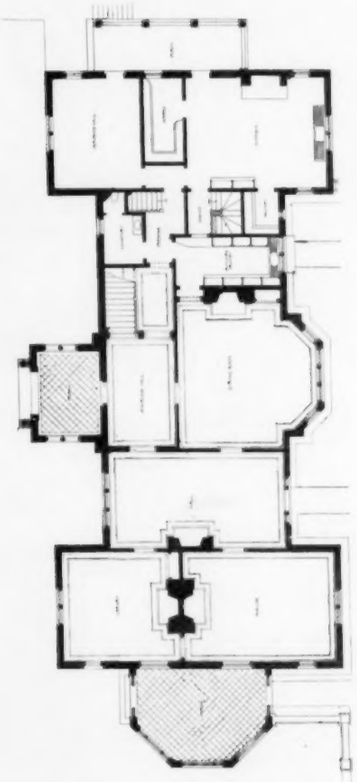
McKIM, MEAD & WHITE, ARCHITECTS.

SOUTH ELEVATION



NORTH ELEVATION





First Floor Plan.

HOUSE FOR W. B. BOULTON, Esq..
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T. HENRY RANDALL, Architect.

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Please Write to any one of these Architects for their Opinions on our Tiles.

NEW YORK OFFICE,
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156 FIFTH AVENUE.

CHICAGO OFFICE,
Suite 1001-2,
204 DEARBORN STREET.

THE DELMONICO BUILDING, 44TH STREET AND FIFTH AVE., NEW YORK CITY.

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